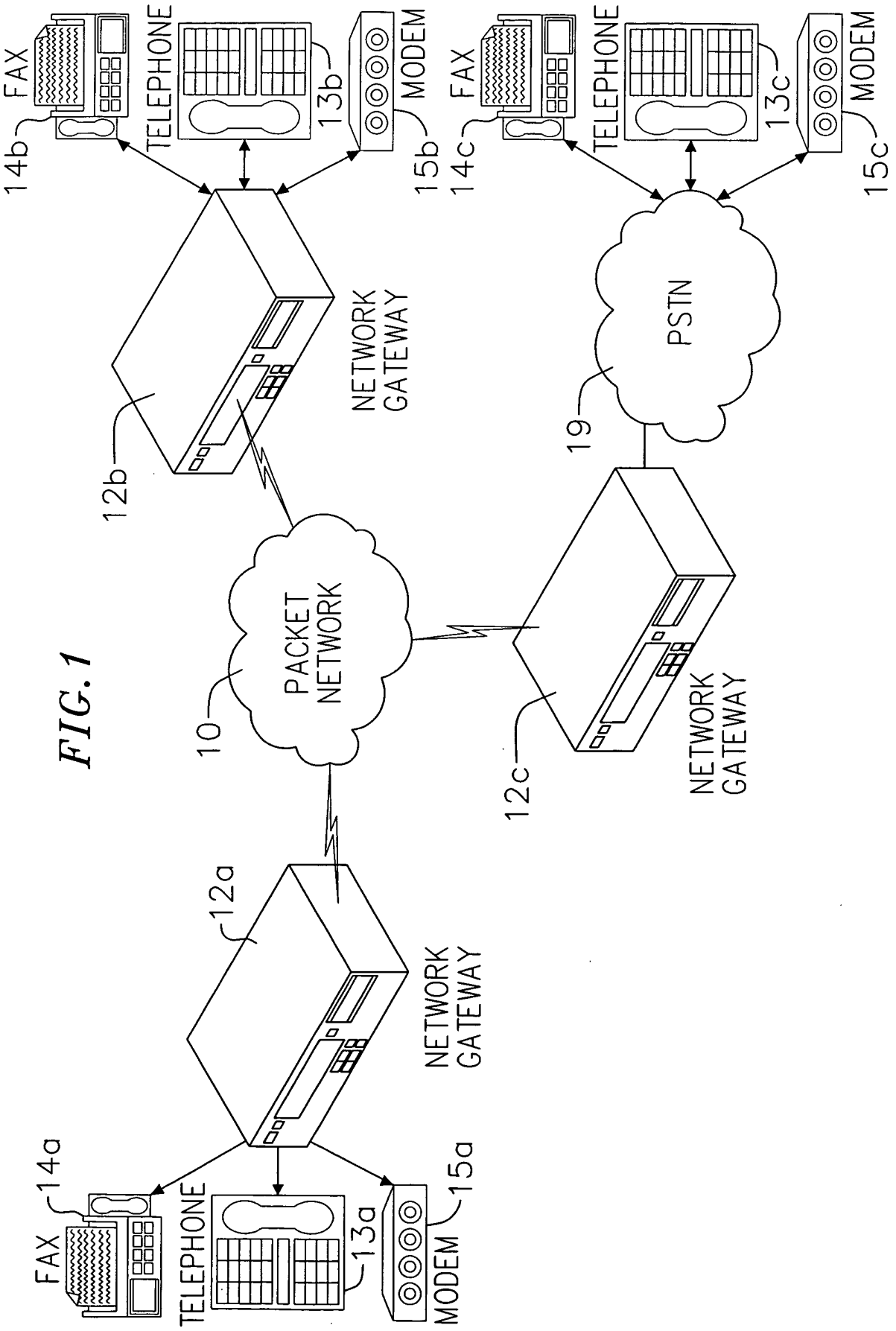
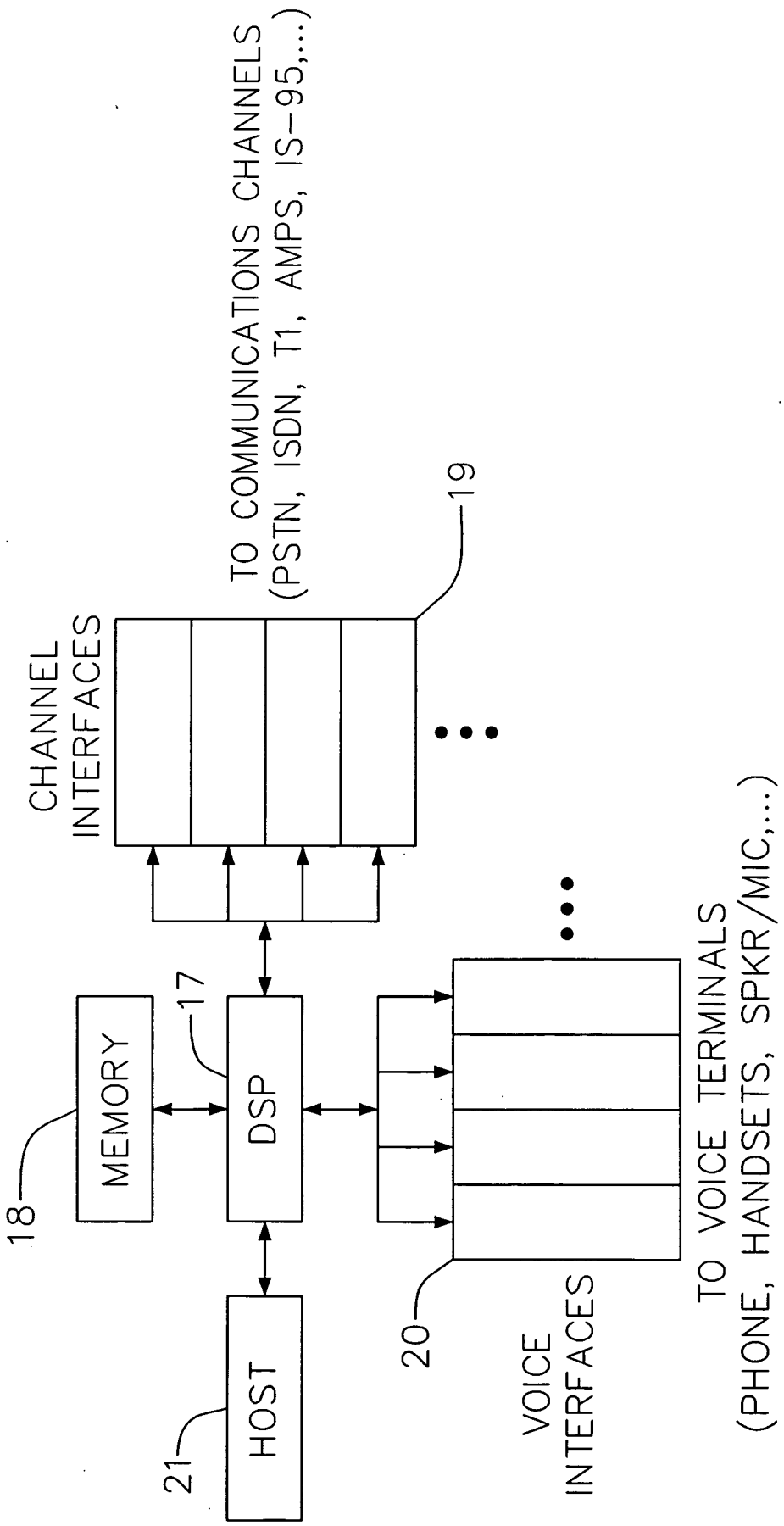

FAX
14b
TELEPHONE
13b
MODEM
15b
FAX
14c
TELEPHONE
13c
MODEM
15c
12b
NETWORK GATEWAY
PSTN
19
10
PACKET NETWORK
12c
NETWORK GATEWAY
12a
NETWORK GATEWAY
FAX
14a
TELEPHONE
13a
MODEM
15a

FIG. 1

FIG.2


TO COMMUNICATIONS CHANNELS
(PSTN, ISDN, T1, AMPS, IS-95,...)
19
CHANNEL
INTERFACES
18
MEMORY
17
DSP
HOST
21
20
VOICE
INTERFACES
TO VOICE TERMINALS
(PHONE, HANDSETS, SPKR/MIC,...)

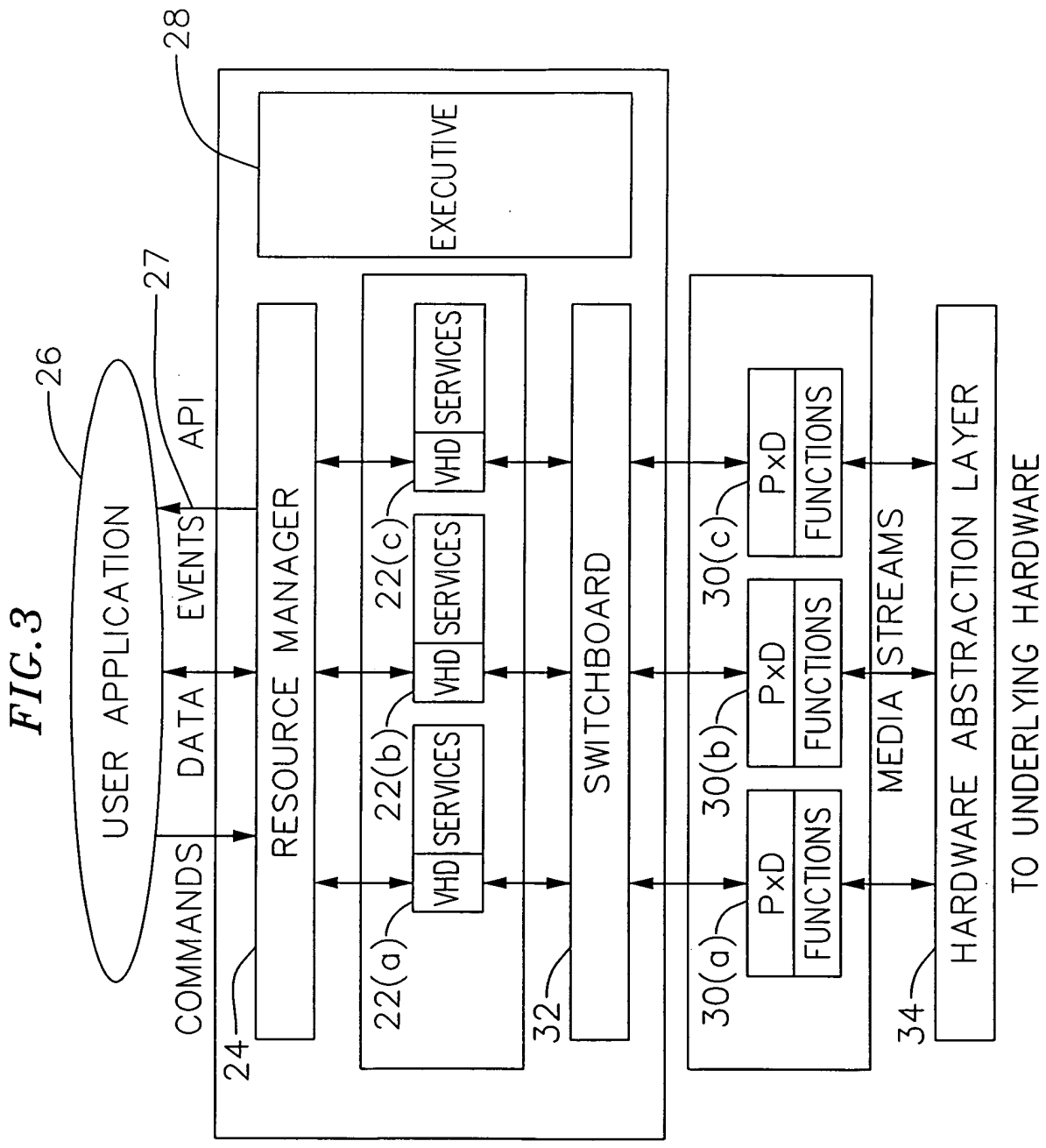
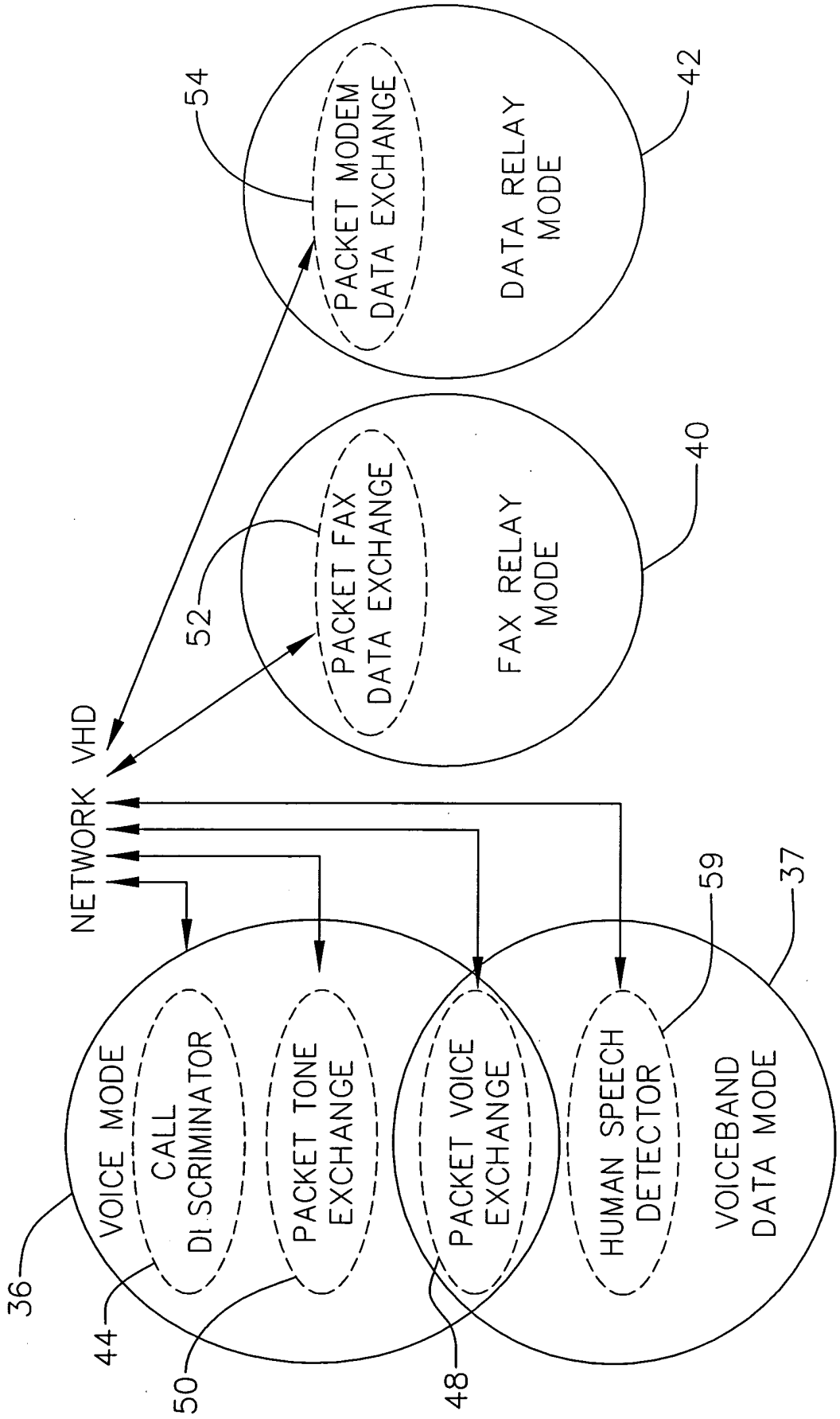

28
EXECUTIVE
27
API
26
USER APPLICATION
EVENTS
DATA
COMMANDS
RESOURCE MANAGER
24
VHD SERVICES
22(a)
22(b)
22(c)
SWITCHBOARD
32
PxD FUNCTIONS
30(a)
30(b)
30(c)
MEDIA STREAMS
HARDWARE ABSTRACTION LAYER
34
TO UNDERLYING HARDWARE

FIG. 3

FIG. 4


NETWORK VHD
DATA RELAY MODE
PACKET MODEM DATA EXCHANGE
FAX RELAY MODE
PACKET FAX DATA EXCHANGE
VOICE MODE
CALL DISCRIMINATOR
PACKET TONE EXCHANGE
PACKET VOICE EXCHANGE
HUMAN SPEECH DETECTOR
VOICEBAND DATA MODE
36
37
40
42
44
48
50
52
54
59

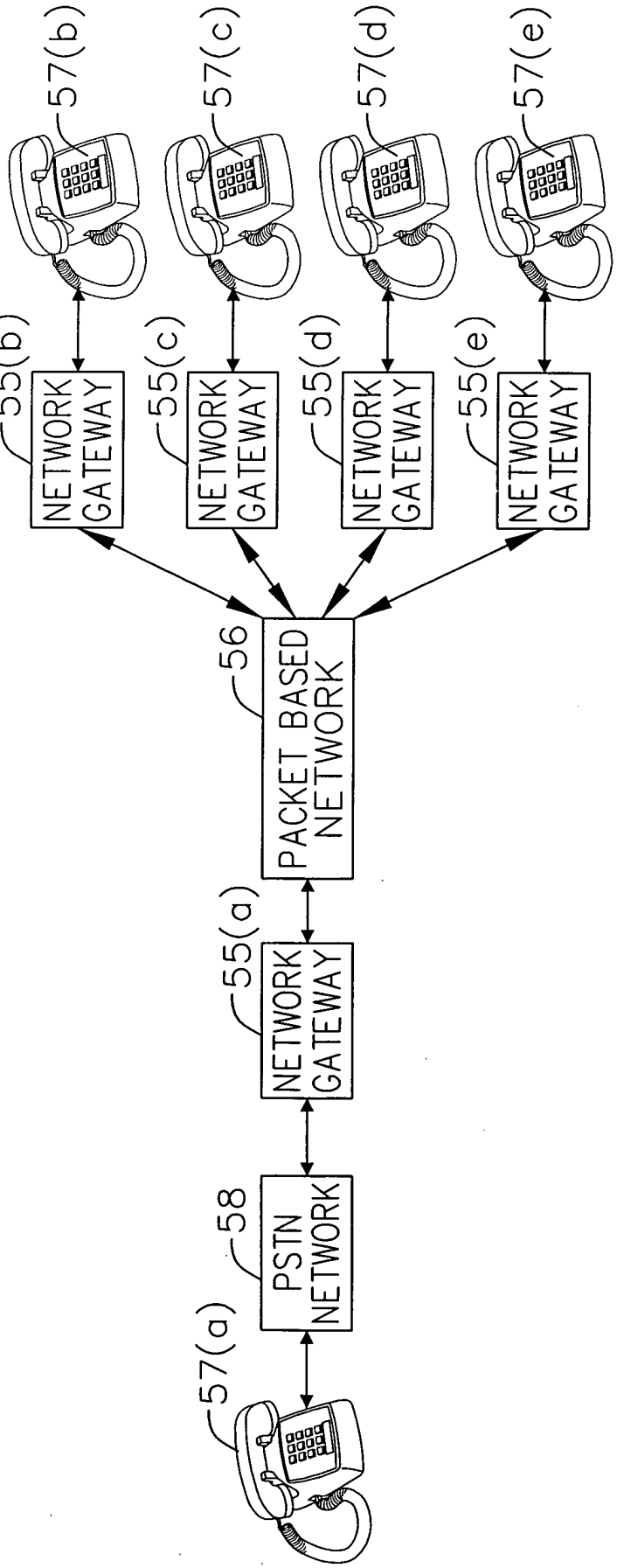

57(b)
57(c)
57(d)
57(e)
55(b)
55(c)
55(d)
55(e)
NETWORK GATEWAY
NETWORK GATEWAY
NETWORK GATEWAY
NETWORK GATEWAY
56
PACKET BASED NETWORK
55(a)
NETWORK GATEWAY
58
PSTN NETWORK
57(a)

FIG. 5

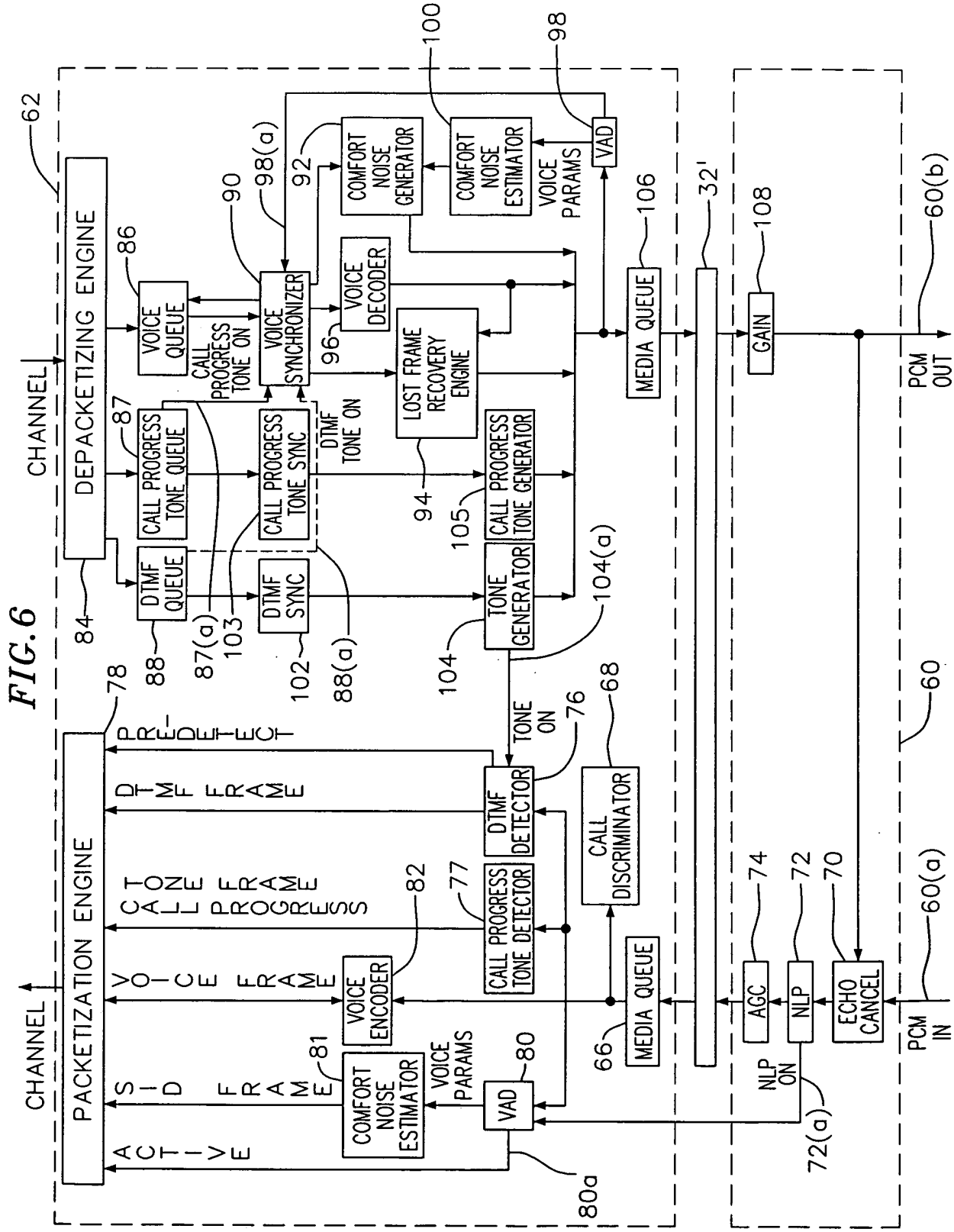
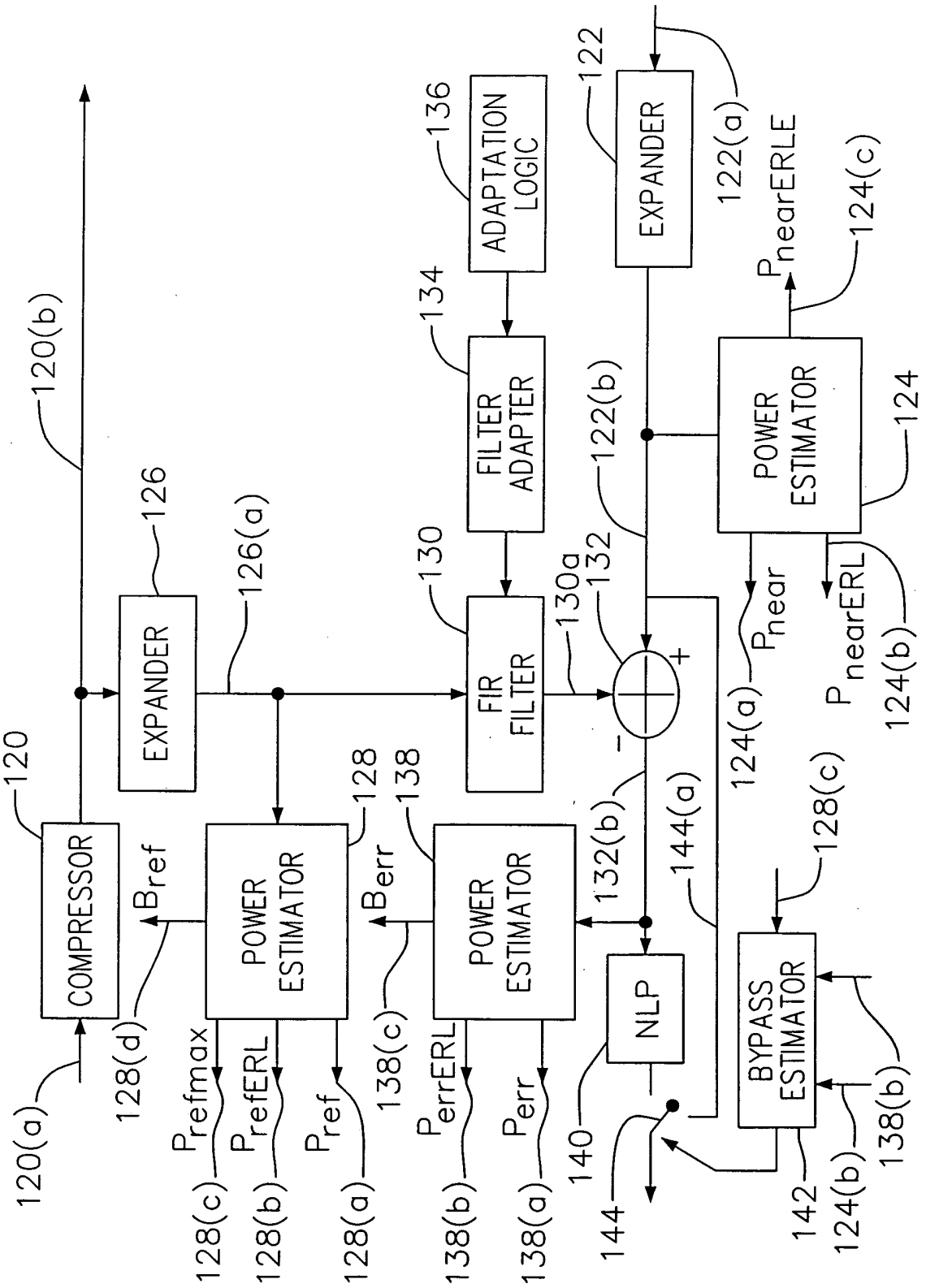

62
CHANNEL
DEPACKETIZING ENGINE
84
VOICE QUEUE
86
CALL PROGRESS TONE QUEUE
87
DTMF QUEUE
88
87(a)
103
CALL PROGRESS TONE ON
VOICE SYNCHRONIZER
90
CALL PROGRESS TONE SYNC
DTMF SYNC
102
88(a)
DTMF TONE ON
98(a)
92
COMFORT NOISE GENERATOR
100
COMFORT NOISE ESTIMATOR
98
VOICE PARAMS
VAD
VOICE DECODER
96
LOST FRAME RECOVERY ENGINE
94
105
CALL PROGRESS TONE GENERATOR
TONE GENERATOR
104
104(a)
106
MEDIA QUEUE
32'
108
GAIN
60(b)
PCM OUT
PRE-DETECT
78
TONE ON
76
68
DTMF FRAME
DTMF DETECTOR
CALL DISCRIMINATOR
CTONE FRAME
CALL PROGRESS
82
77
CALL PROGRESS TONE DETECTOR
VOICE FRAME
VOICE ENCODER
81
SID FRAME
COMFORT NOISE ESTIMATOR
VOICE PARAMS
VAD
80
ACTIVE
80a
PACKETIZATION ENGINE
CHANNEL
66
MEDIA QUEUE
74
AGC
72
NLP
70
ECHO CANCEL
60(a)
PCM IN
NLP ON
72(a)
60

FIG. 6

FIG. 7


120
COMPRESSOR
120(a)
120(b)
126
EXPANDER
126(a)
128
POWER ESTIMATOR
128(a)
128(b)
128(c)
128(d)
Bref
Prefmax
PrefERL
Pref
130
FIR FILTER
130a
132
132(b)
134
FILTER ADAPTER
136
ADAPTATION LOGIC
138
POWER ESTIMATOR
138(a)
138(b)
138(c)
Berr
PerrERL
Perr
140
NLP
144
144(a)
122
EXPANDER
122(a)
122(b)
124
POWER ESTIMATOR
124(a)
124(b)
124(c)
Pnear
PnearERL
PnearERLE
128(c)
BYPASS ESTIMATOR
142
138(b)

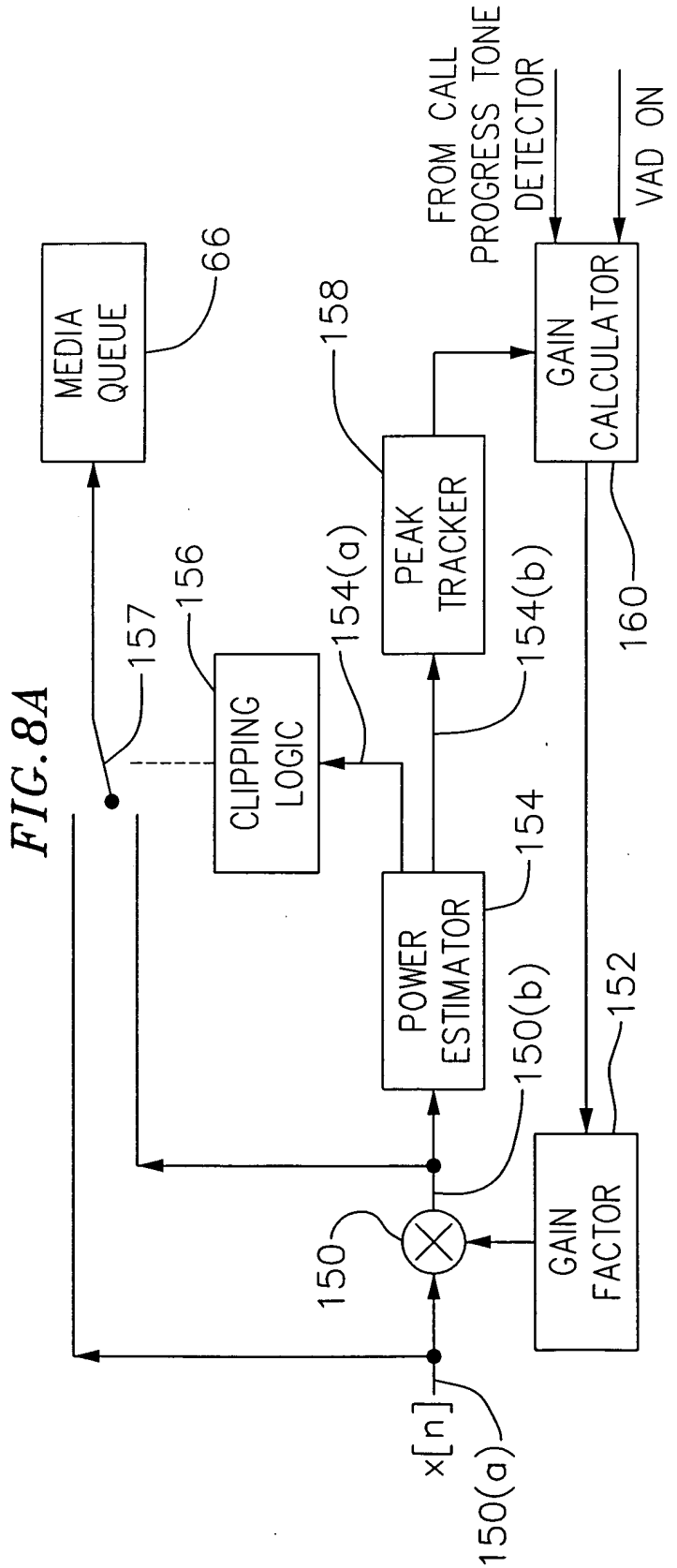

MEDIA QUEUE
66
FROM CALL PROGRESS TONE DETECTOR
VAD ON
158
GAIN CALCULATOR
PEAK TRACKER
157
156
154(a)
154(b)
160
CLIPPING LOGIC
POWER ESTIMATOR
154
150(b)
152
150
GAIN FACTOR
x[n]
150(a)

FIG. 8A

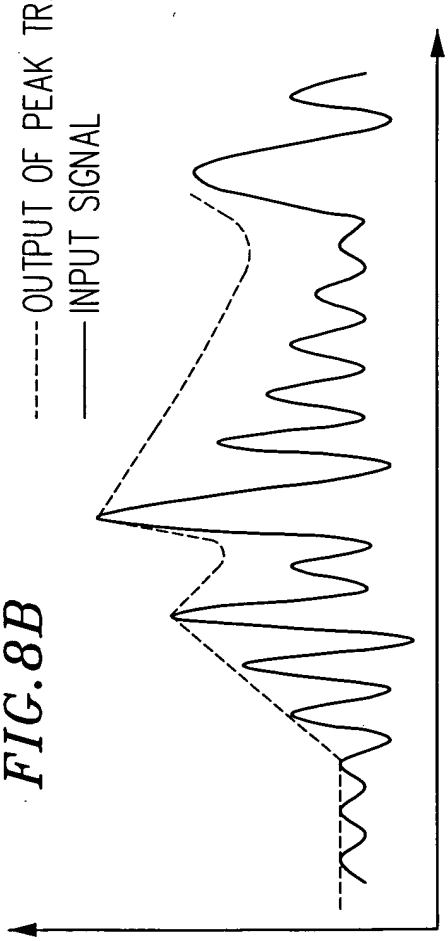
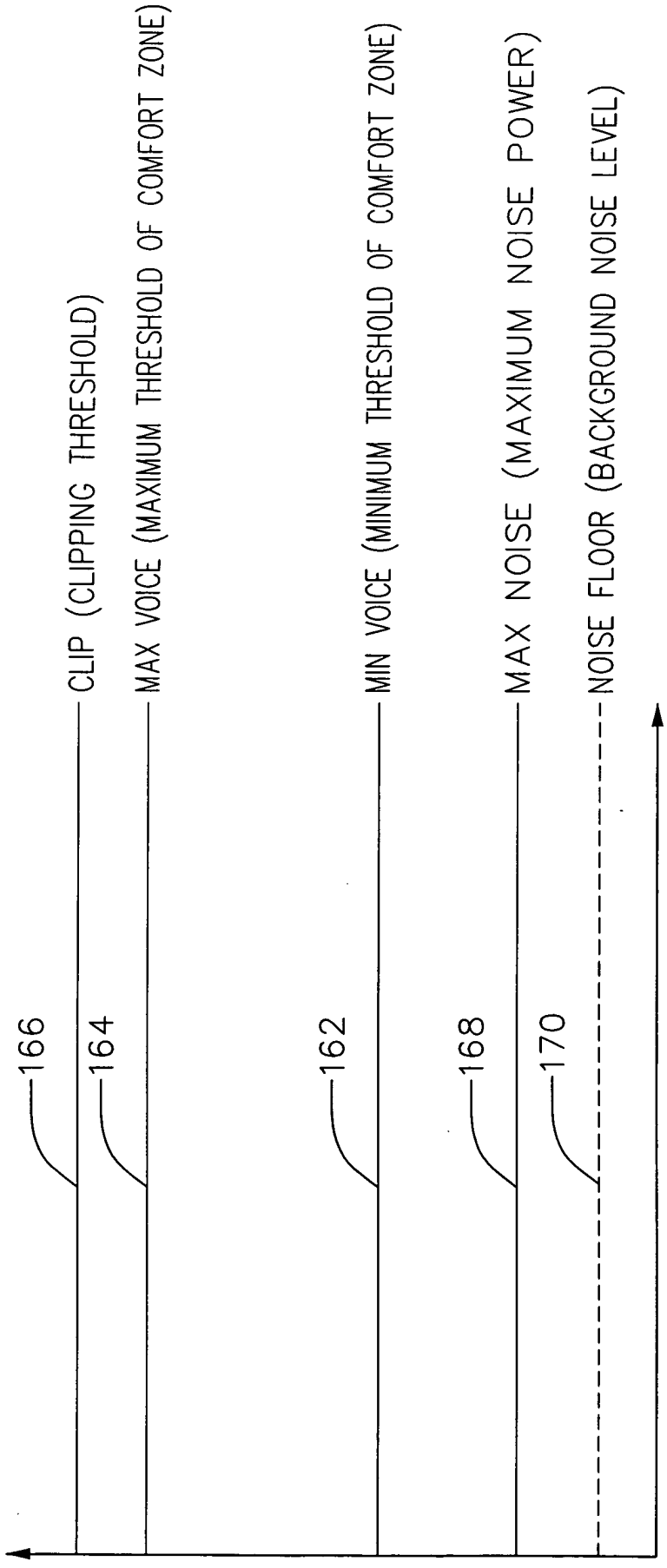

OUTPUT OF PEAK TRACKER
INPUT SIGNAL

FIG. 8B

FIG. 9


CLIP (CLIPPING THRESHOLD)
MAX VOICE (MAXIMUM THRESHOLD OF COMFORT ZONE)
MIN VOICE (MINIMUM THRESHOLD OF COMFORT ZONE)
MAX NOISE (MAXIMUM NOISE POWER)
NOISE FLOOR (BACKGROUND NOISE LEVEL)
166
164
162
168
170

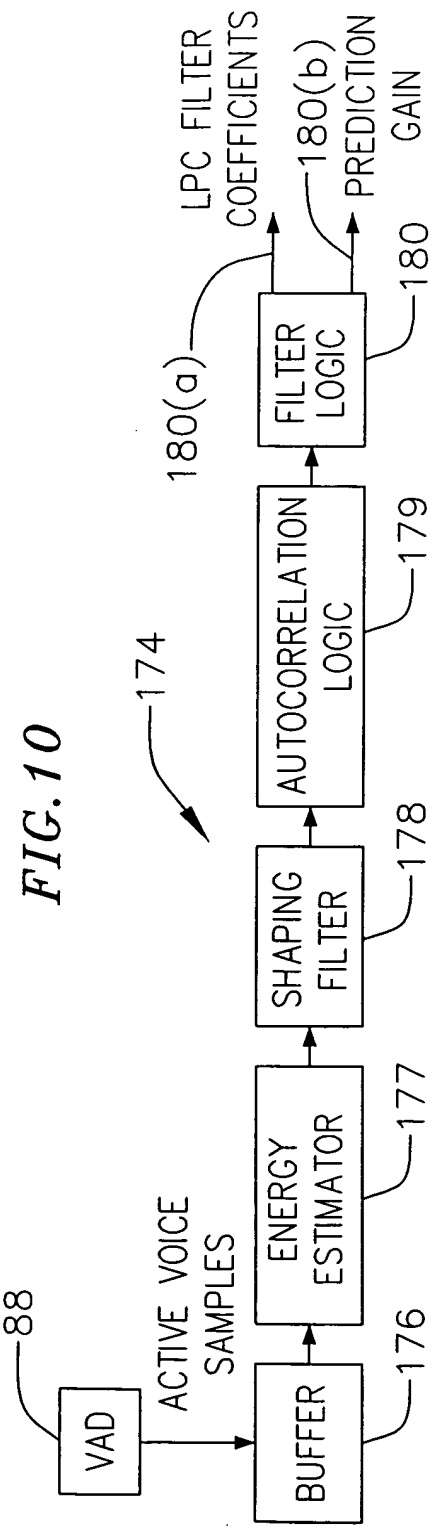

88
VAD
ACTIVE VOICE SAMPLES
BUFFER
176
ENERGY ESTIMATOR
177
SHAPING FILTER
178
AUTOCORRELATION LOGIC
179
FILTER LOGIC
180
180(a)
LPC FILTER COEFFICIENTS
180(b)
PREDICTION GAIN
174

FIG. 10

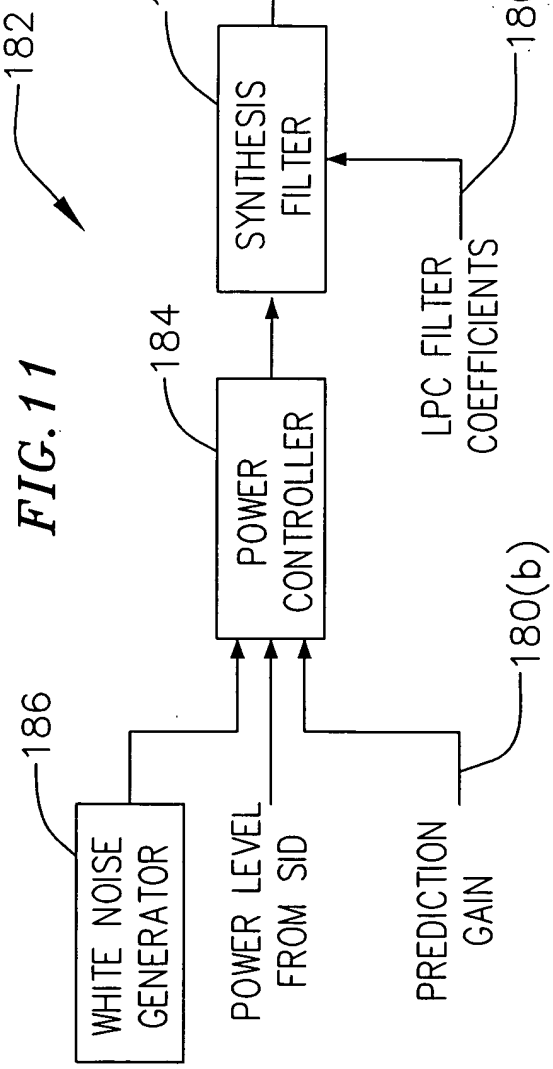

182
186
WHITE NOISE GENERATOR
POWER LEVEL FROM SID
184
POWER CONTROLLER
PREDICTION GAIN
180(b)
188
SYNTHESIS FILTER
LPC FILTER COEFFICIENTS
180(a)

FIG. 11

FIG. 12

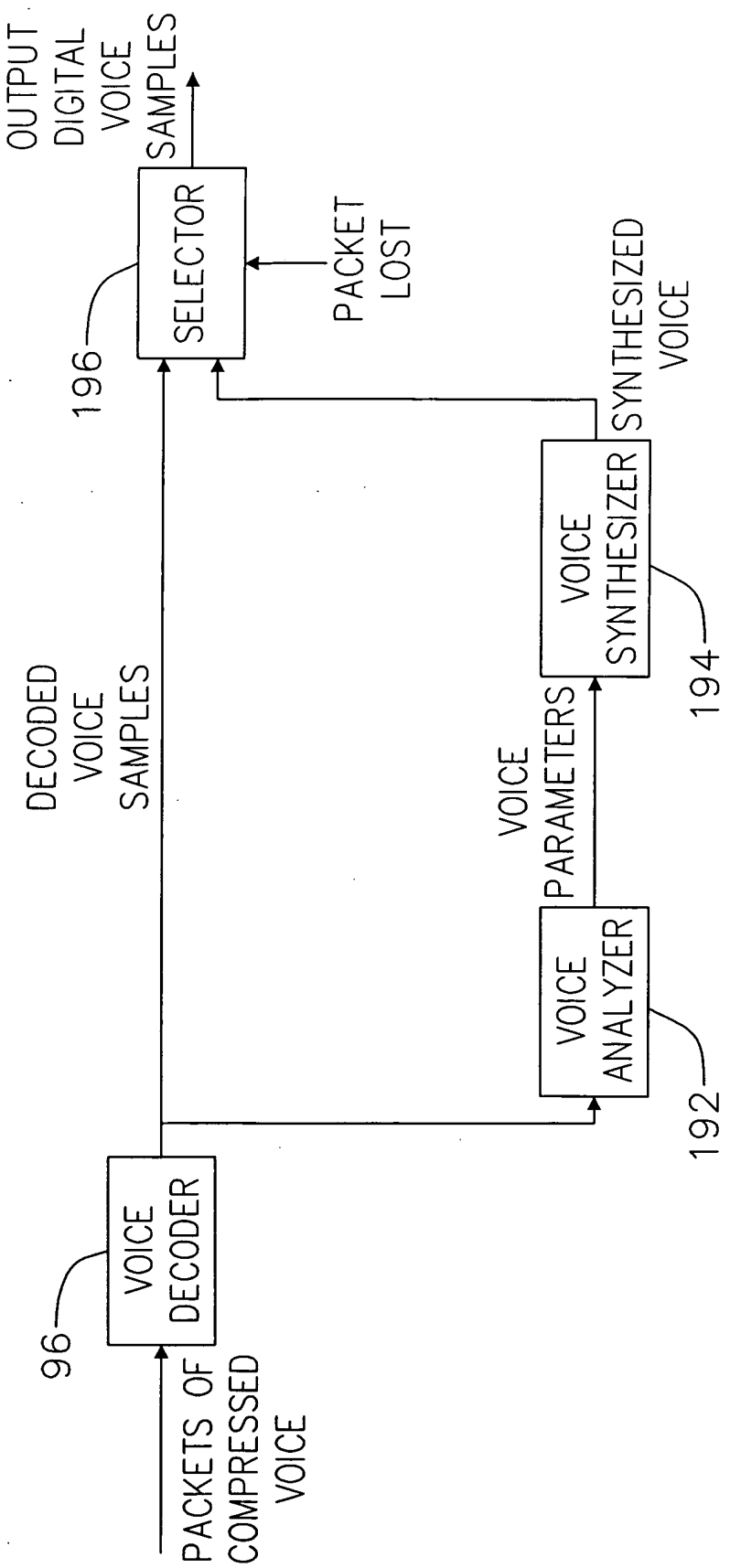

OUTPUT DIGITAL VOICE SAMPLES
SELECTOR
196
PACKET LOST
SYNTHESIZED VOICE
VOICE SYNTHESIZER
194
DECODED VOICE SAMPLES
VOICE PARAMETERS
VOICE ANALYZER
192
VOICE DECODER
96
PACKETS OF COMPRESSED VOICE

FIG. 13A

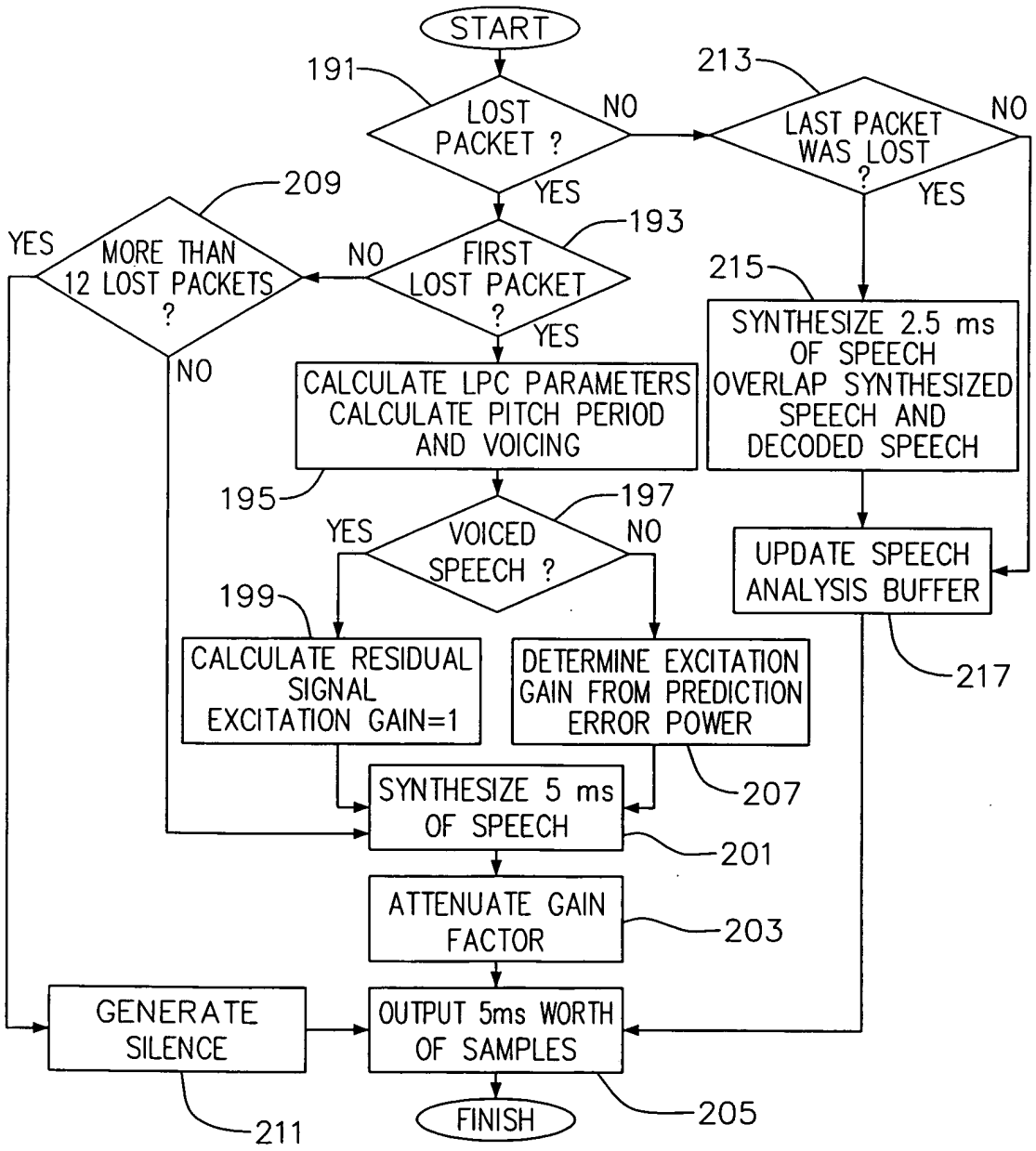

START
191
LOST PACKET ?
NO
YES
213
LAST PACKET WAS LOST ?
NO
YES
209
MORE THAN 12 LOST PACKETS ?
YES
NO
193
FIRST LOST PACKET ?
NO
YES
215
SYNTHESIZE 2.5 ms OF SPEECH OVERLAP SYNTHESIZED SPEECH AND DECODED SPEECH
CALCULATE LPC PARAMETERS CALCULATE PITCH PERIOD AND VOICING
195
197
VOICED SPEECH ?
YES
NO
UPDATE SPEECH ANALYSIS BUFFER
217
199
CALCULATE RESIDUAL SIGNAL EXCITATION GAIN=1
DETERMINE EXCITATION GAIN FROM PREDICTION ERROR POWER
207
SYNTHESIZE 5 ms OF SPEECH
201
ATTENUATE GAIN FACTOR
203
GENERATE SILENCE
OUTPUT 5ms WORTH OF SAMPLES
211
205
FINISH

FIG. 13B

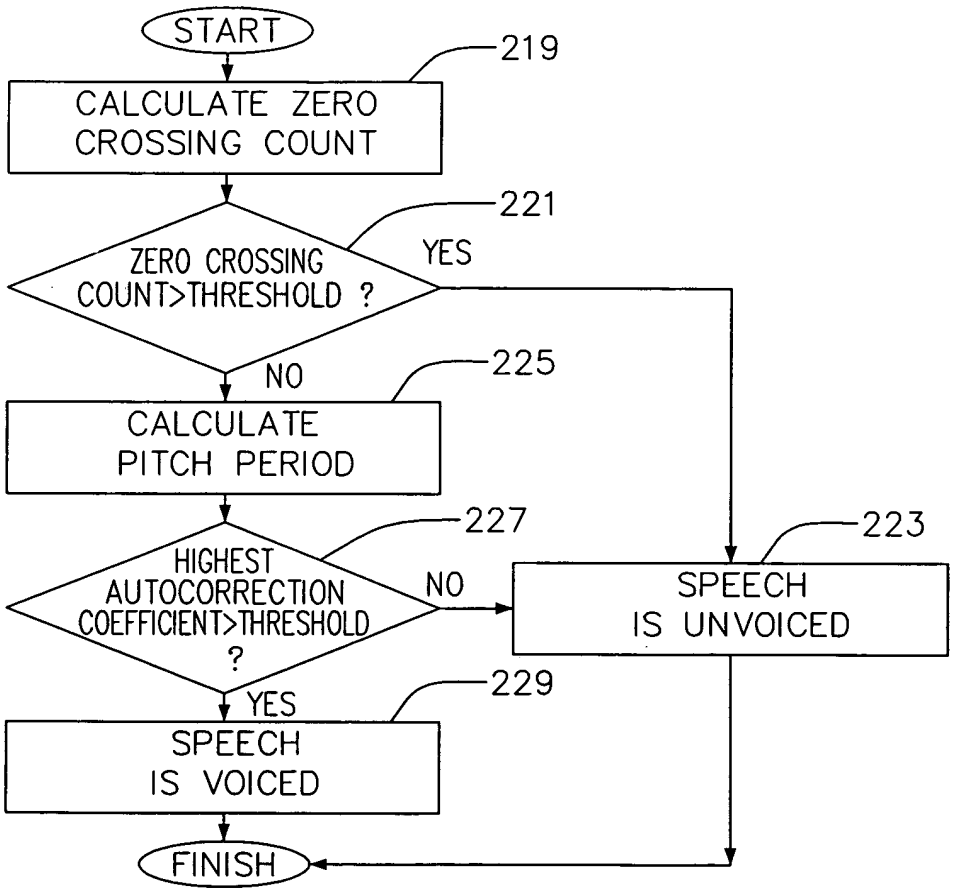

START
219
CALCULATE ZERO CROSSING COUNT
221
ZERO CROSSING COUNT>THRESHOLD ?
YES
NO
225
CALCULATE PITCH PERIOD
227
HIGHEST AUTOCORRECTION COEFFICIENT>THRESHOLD ?
NO
223
SPEECH IS UNVOICED
YES
229
SPEECH IS VOICED
FINISH

FIG. 13C

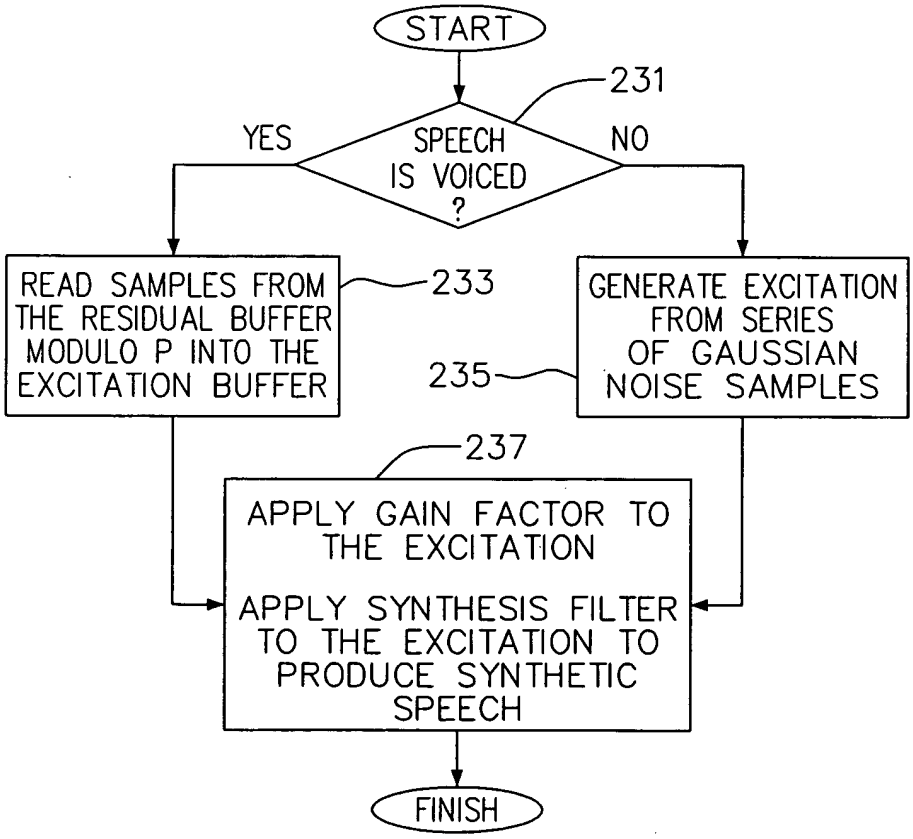

START
231
YES
SPEECH IS VOICED ?
NO
READ SAMPLES FROM THE RESIDUAL BUFFER MODULO P INTO THE EXCITATION BUFFER
233
GENERATE EXCITATION FROM SERIES OF GAUSSIAN NOISE SAMPLES
235
237
APPLY GAIN FACTOR TO THE EXCITATION
APPLY SYNTHESIS FILTER TO THE EXCITATION TO PRODUCE SYNTHETIC SPEECH
FINISH

FIG. 14

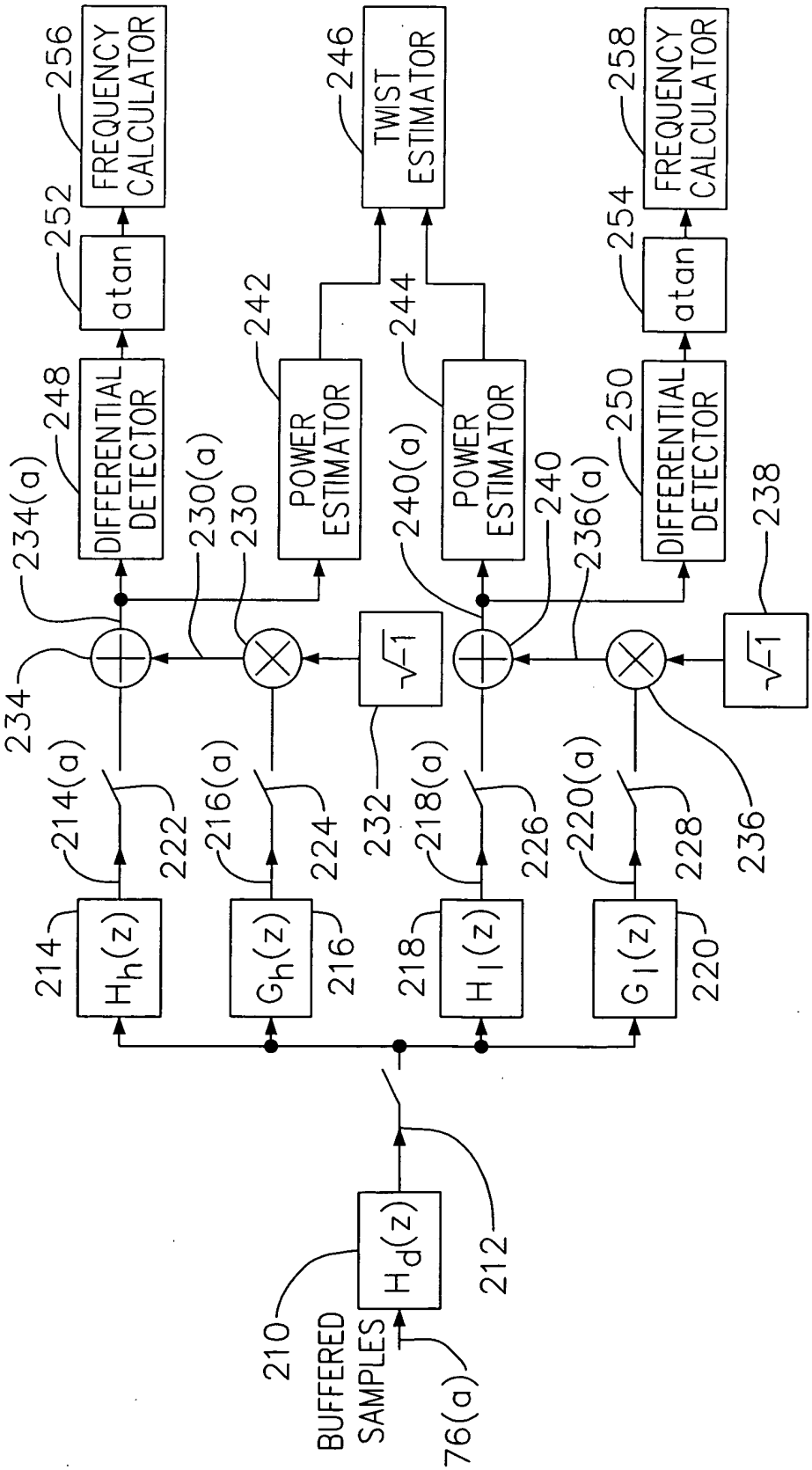

210
BUFFERED SAMPLES
76(a)
$H_d(z)$
212
214
$H_h(z)$
214(a)
222
216
$G_h(z)$
216(a)
224
218
$H_l(z)$
218(a)
226
220
$G_l(z)$
220(a)
228
232
$\sqrt{-1}$
234
234(a)
230
230(a)
236
236(a)
238
$\sqrt{-1}$
240
240(a)
242
POWER ESTIMATOR
244
POWER ESTIMATOR
246
TWIST ESTIMATOR
248
DIFFERENTIAL DETECTOR
250
DIFFERENTIAL DETECTOR
252
atan
254
atan
256
FREQUENCY CALCULATOR
258
FREQUENCY CALCULATOR

FIG. 14A

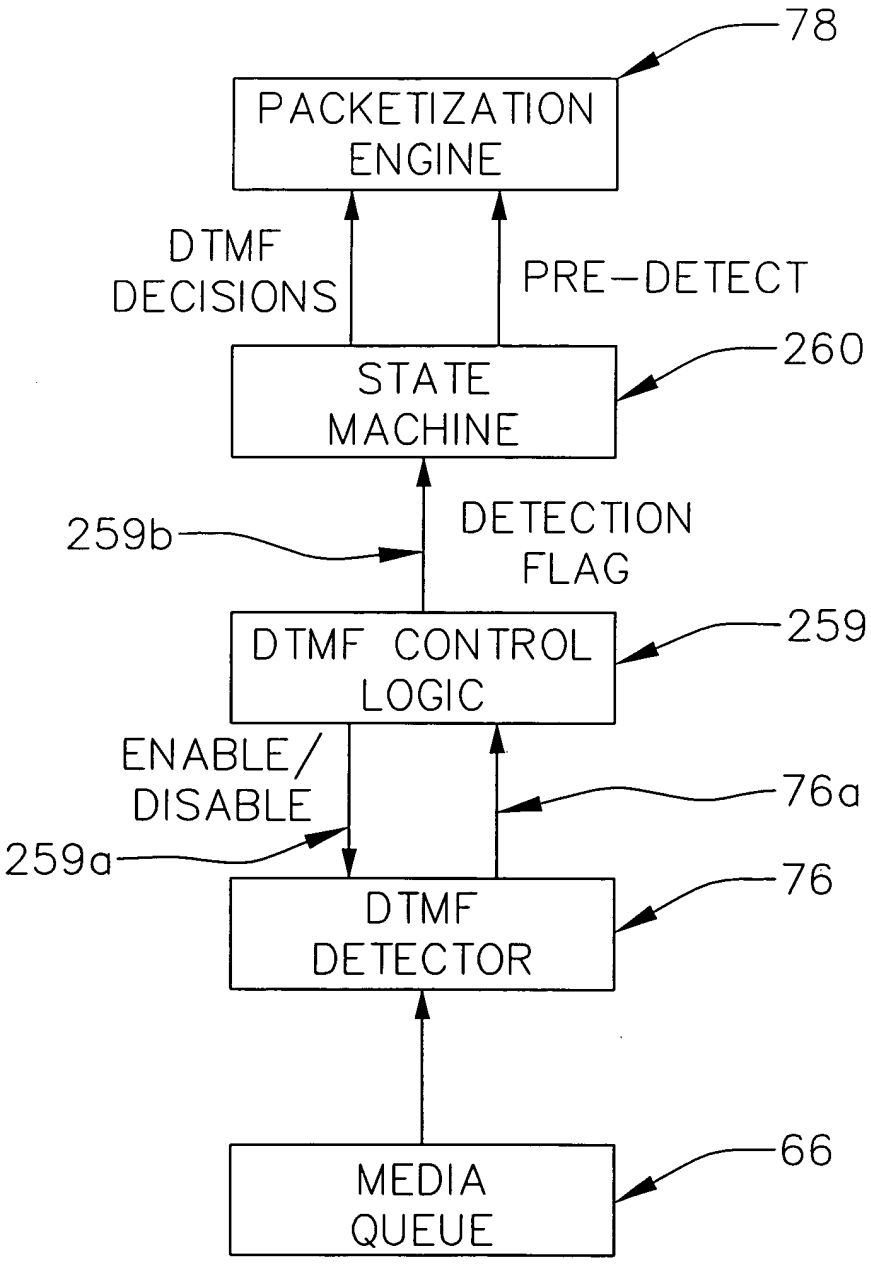
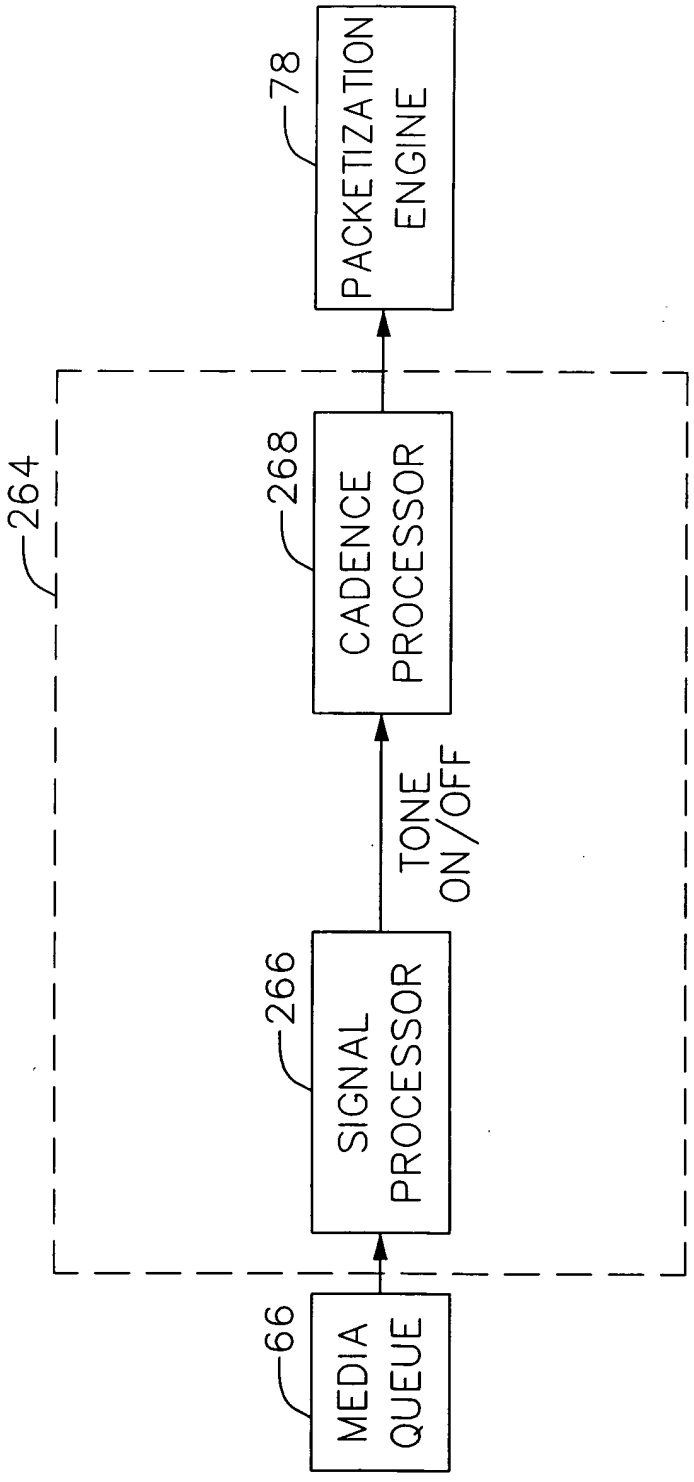

78
PACKETIZATION ENGINE
DTMF DECISIONS
PRE-DETECT
260
STATE MACHINE
259b
DETECTION FLAG
259
DTMF CONTROL LOGIC
ENABLE/ DISABLE
76a
259a
76
DTMF DETECTOR
66
MEDIA QUEUE

FIG. 15


78
PACKETIZATION ENGINE
264
268
CADENCE PROCESSOR
TONE ON/OFF
266
SIGNAL PROCESSOR
66
MEDIA QUEUE

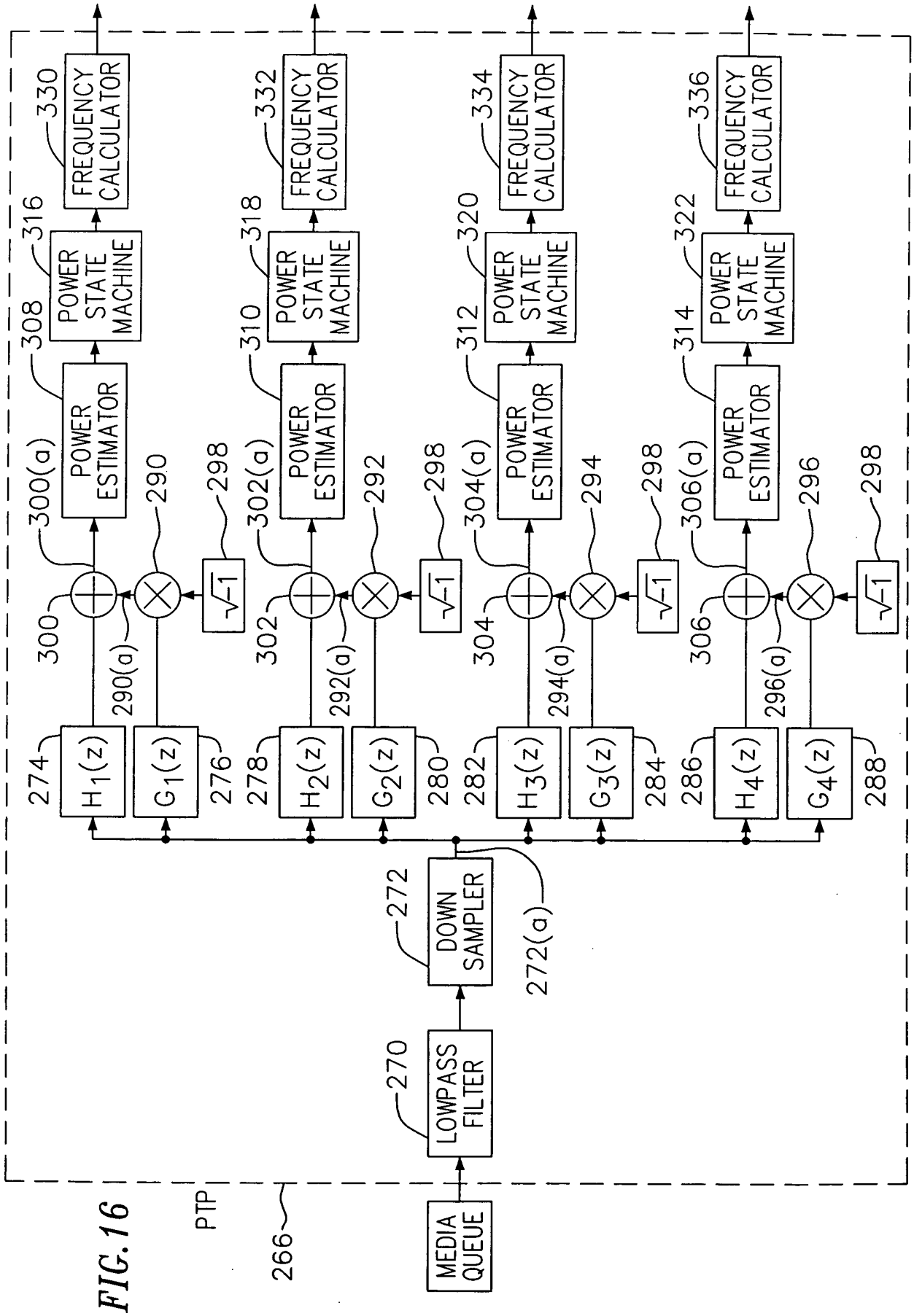

MEDIA QUEUE
266
PTP
LOWPASS FILTER
270
DOWN SAMPLER
272
272(a)
H1(z)
274
G1(z)
276
H2(z)
278
G2(z)
280
H3(z)
282
G3(z)
284
H4(z)
286
G4(z)
288
290(a)
290
292(a)
292
294(a)
294
296(a)
296
√-1
298
300
300(a)
302
302(a)
304
304(a)
306
306(a)
POWER ESTIMATOR
308
310
312
314
POWER STATE MACHINE
316
318
320
322
FREQUENCY CALCULATOR
330
332
334
336

FIG. 16

FIG. 17

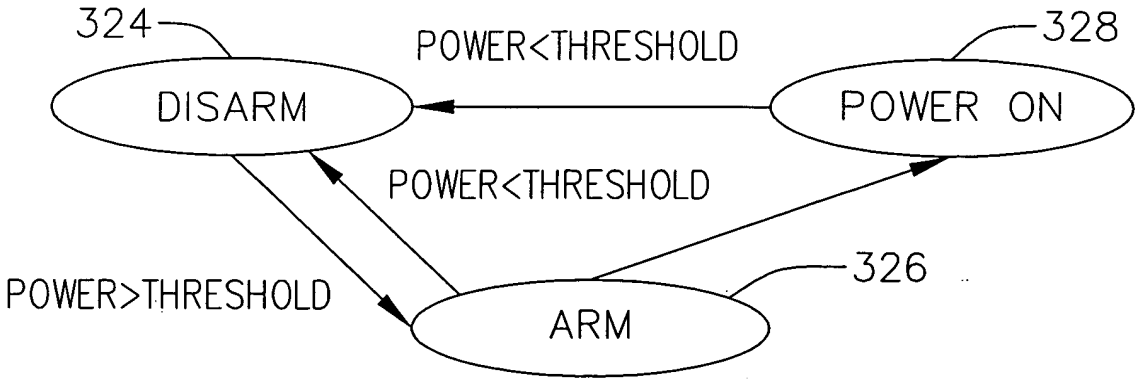

324
POWER<THRESHOLD
328
DISARM
POWER ON
POWER<THRESHOLD
POWER>THRESHOLD
326
ARM

FIG. 18

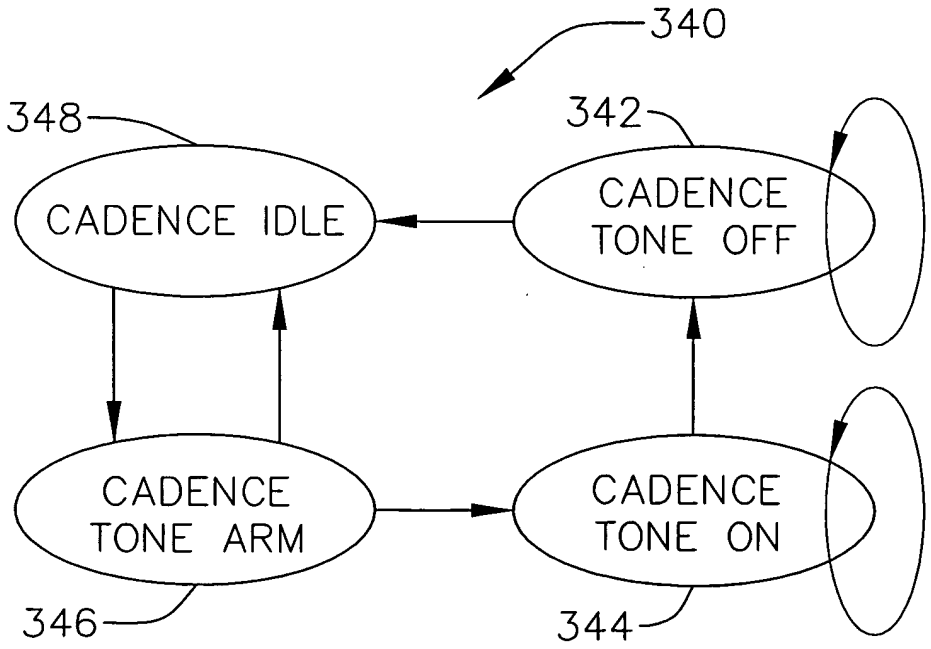

340
348
342
CADENCE IDLE
CADENCE TONE OFF
CADENCE TONE ARM
CADENCE TONE ON
346
344

FIG. 18A

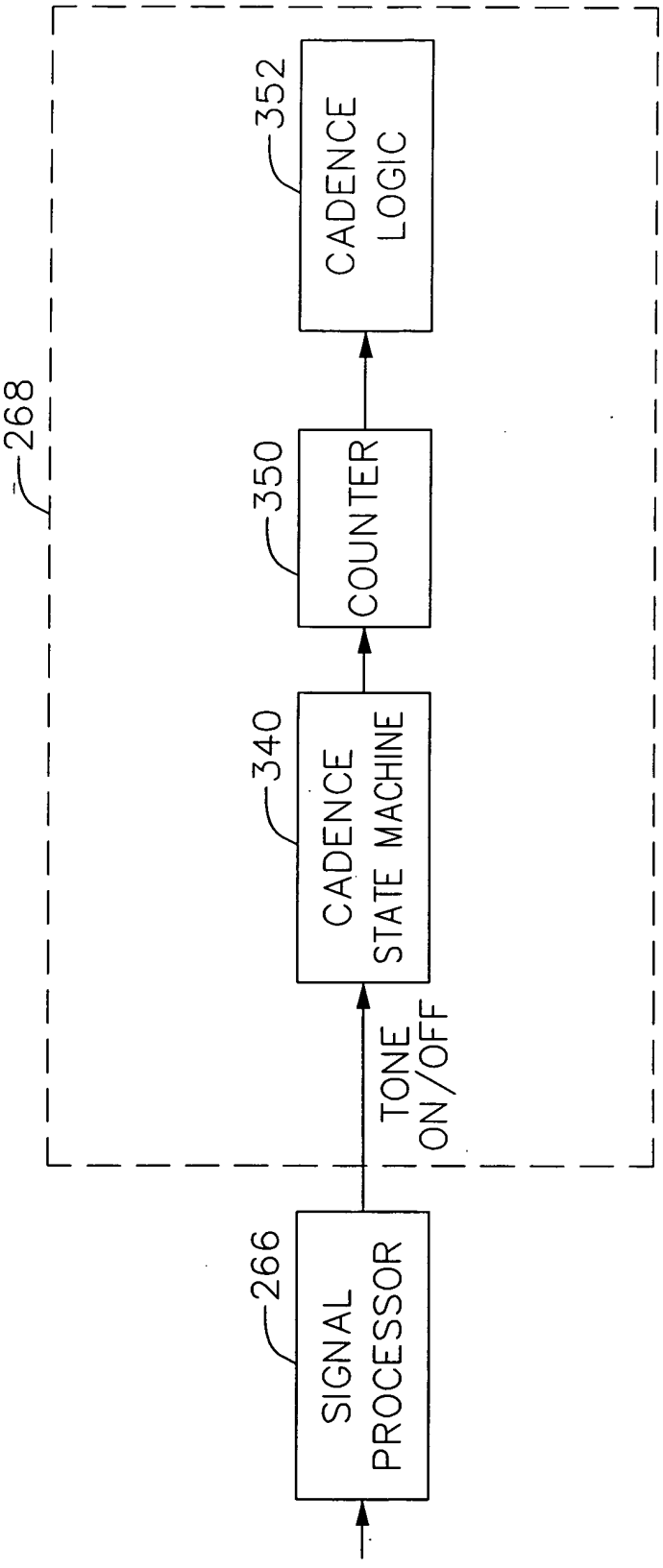
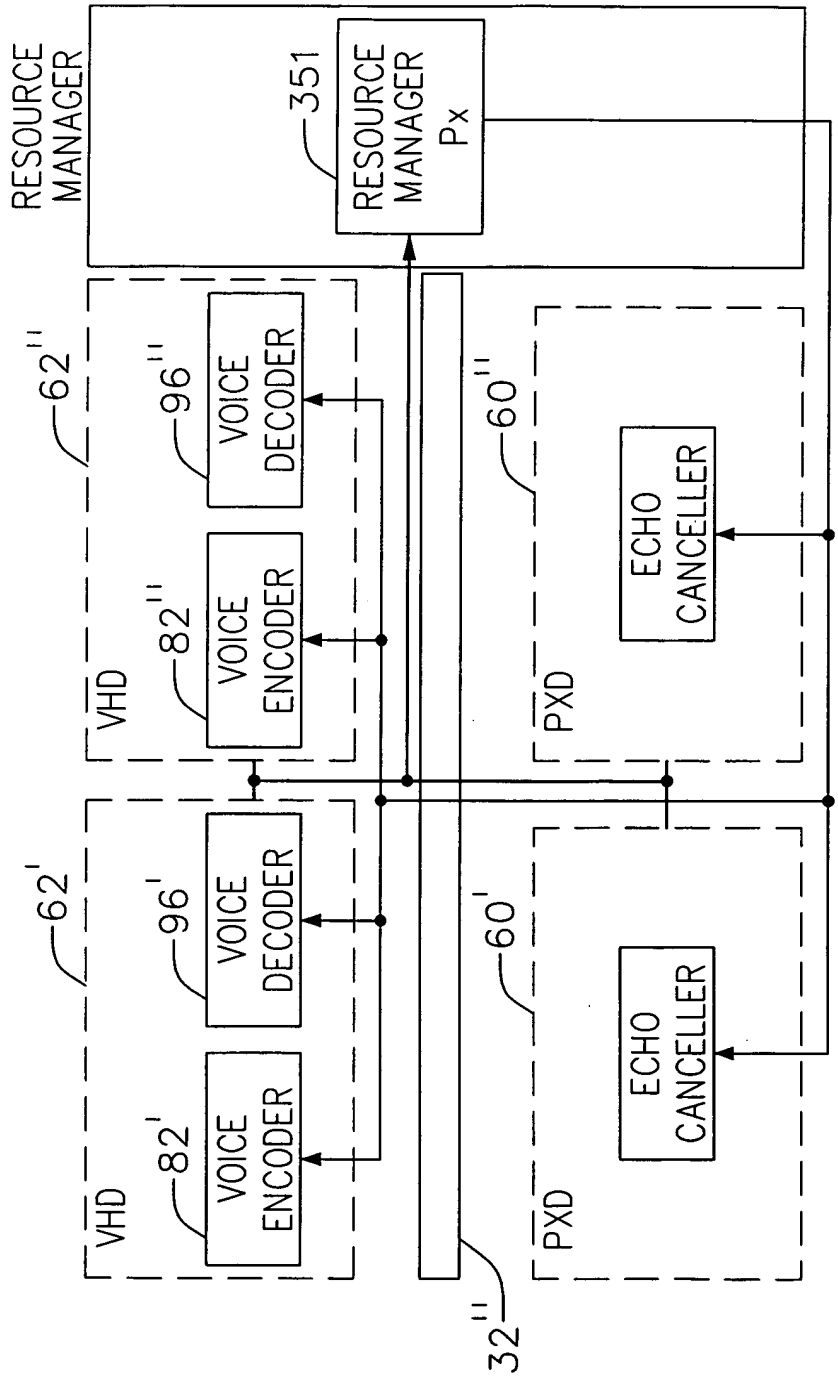

268
352
CADENCE LOGIC
350
COUNTER
340
CADENCE STATE MACHINE
TONE ON/OFF
266
SIGNAL PROCESSOR

FIG. 19


RESOURCE MANAGER
351
RESOURCE MANAGER Px
62''
96''
VOICE DECODER
82''
VOICE ENCODER
VHD
60''
ECHO CANCELLER
PXD
62'
96'
VOICE DECODER
82'
VOICE ENCODER
VHD
60'
ECHO CANCELLER
PXD
32''

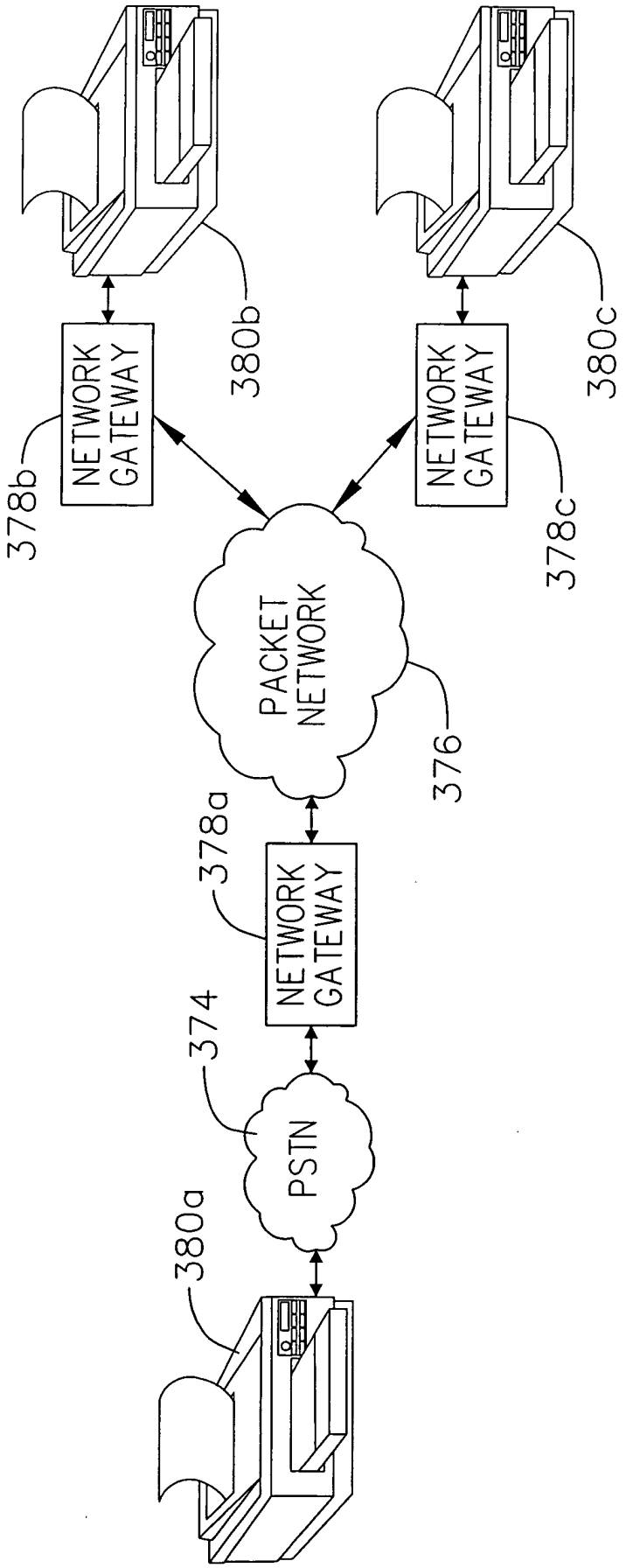

380b
380c
NETWORK GATEWAY
NETWORK GATEWAY
378b
378c
PACKET NETWORK
376
378a
NETWORK GATEWAY
374
PSTN
380a

FIG.20

FIG.21

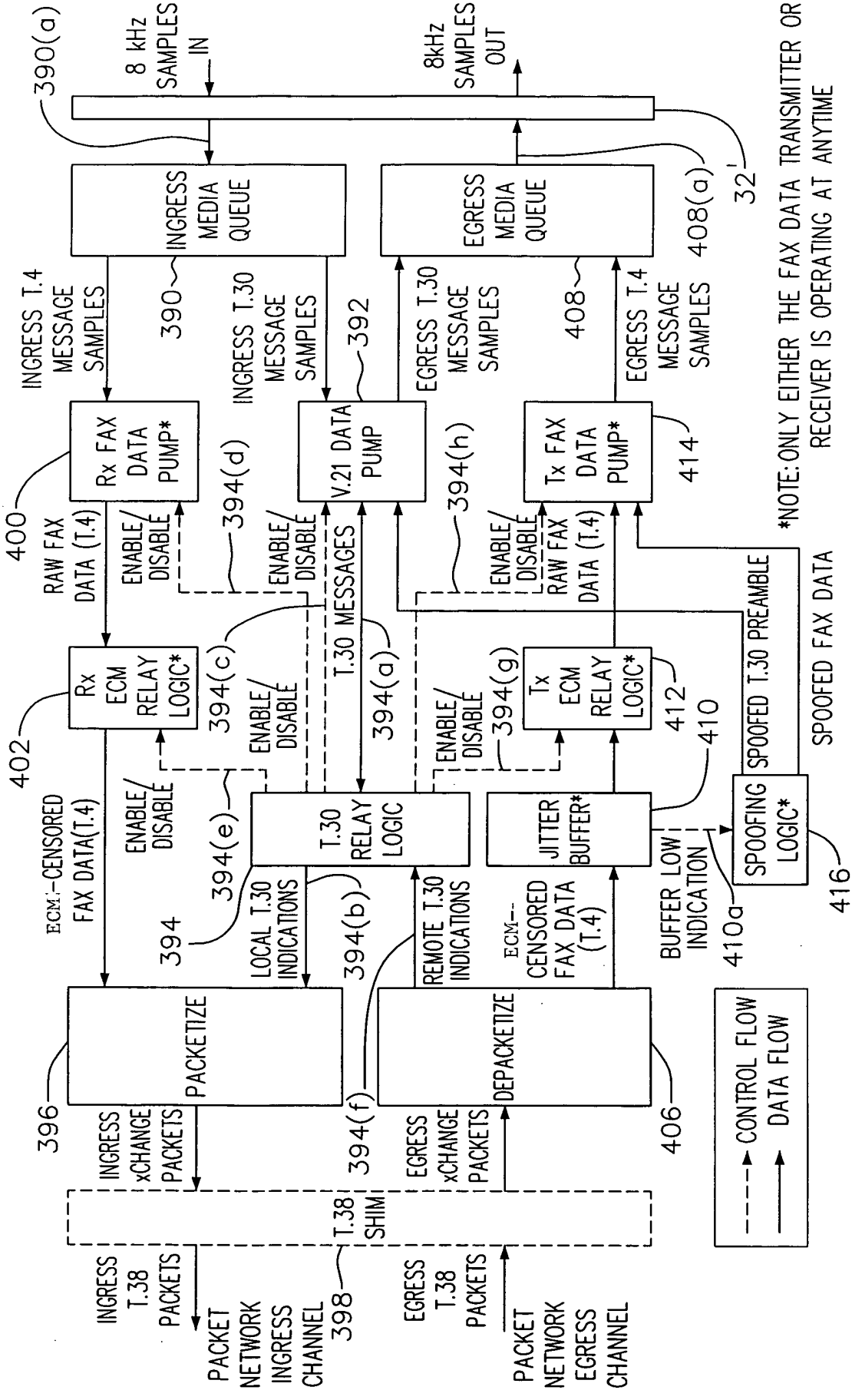

390(a)
8 kHz SAMPLES IN
8kHz SAMPLES OUT
INGRESS MEDIA QUEUE
EGRESS MEDIA QUEUE
32'
408(a)
INGRESS T.4 MESSAGE SAMPLES
390
INGRESS T.30 MESSAGE SAMPLES
392
EGRESS T.30 MESSAGE SAMPLES
408
EGRESS T.4 MESSAGE SAMPLES
400
Rx FAX DATA PUMP*
V.21 DATA PUMP
Tx FAX DATA PUMP*
414
RAW FAX DATA (T.4)
ENABLE/ DISABLE
394(d)
394(h)
*NOTE: ONLY EITHER THE FAX DATA TRANSMITTER OR RECEIVER IS OPERATING AT ANYTIME
402
Rx ECM RELAY LOGIC*
394(c)
T.30 MESSAGES
394(a)
394(g)
Tx ECM RELAY LOGIC*
412
410
SPOOFED T.30 PREAMBLE
SPOOFED FAX DATA
ECM-CENSORED FAX DATA(T.4)
394(e)
T.30 RELAY LOGIC
JITTER BUFFER*
SPOOFING LOGIC*
416
394
LOCAL T.30 INDICATIONS
394(b)
REMOTE T.30 INDICATIONS
ECM-CENSORED FAX DATA (T.4)
BUFFER LOW INDICATION
410a
396
PACKETIZE
DEPACKETIZE
406
INGRESS xCHANGE PACKETS
394(f)
EGRESS xCHANGE PACKETS
T.38 SHIM
CONTROL FLOW
DATA FLOW
INGRESS T.38 PACKETS
PACKET NETWORK INGRESS CHANNEL
398
EGRESS T.38 PACKETS
PACKET NETWORK EGRESS CHANNEL

FIG.22

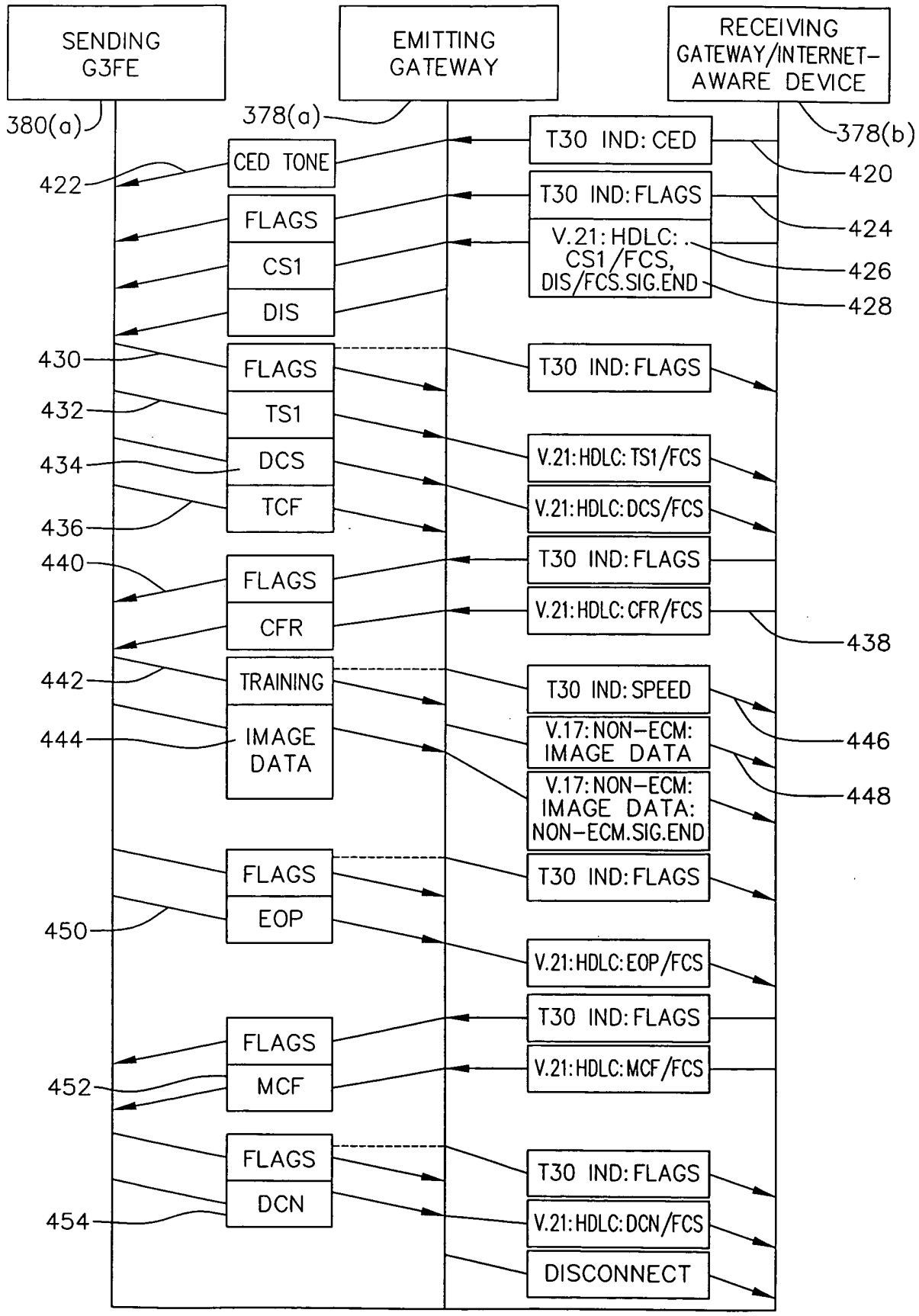
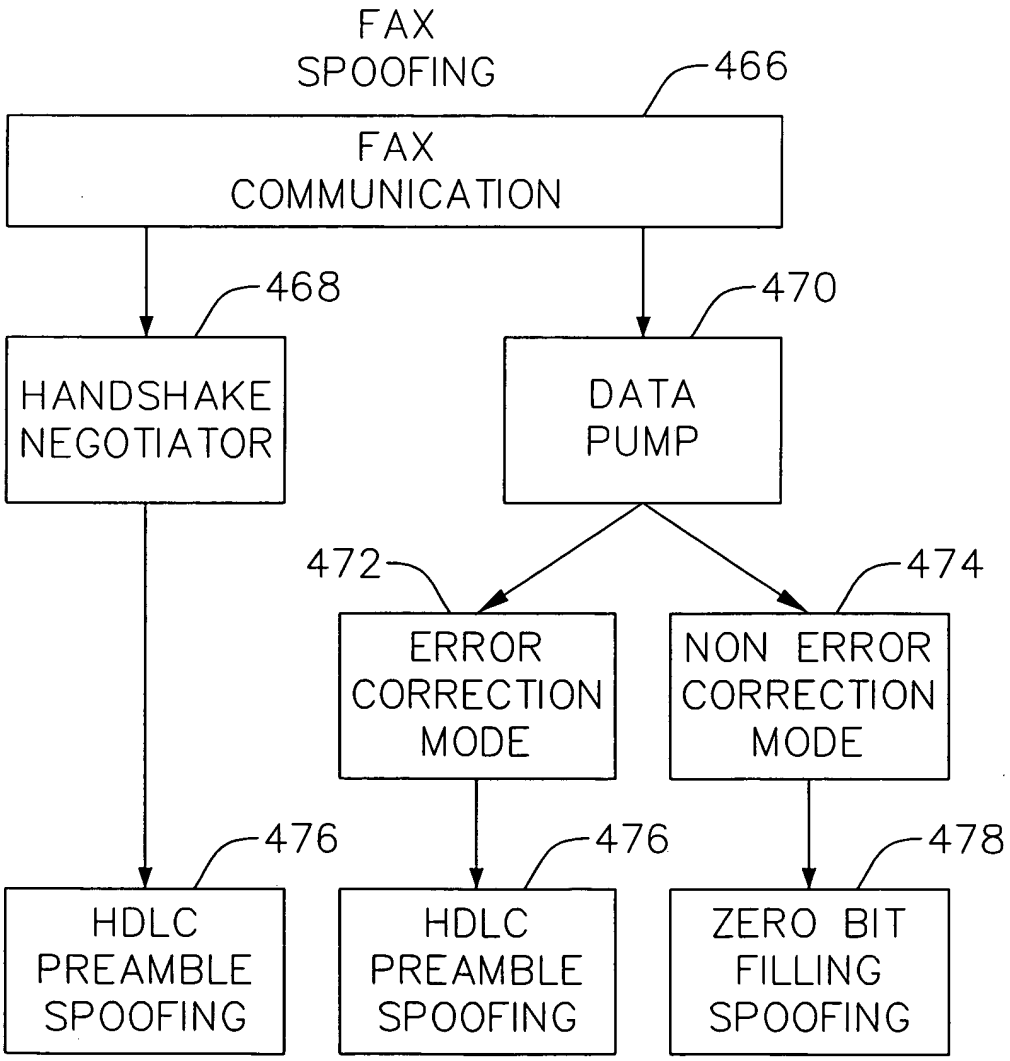

SENDING G3FE
EMITTING GATEWAY
RECEIVING GATEWAY/INTERNET-AWARE DEVICE
380(a)
378(a)
378(b)
CED TONE
422
T30 IND: CED
420
FLAGS
CS1
DIS
T30 IND: FLAGS
424
V.21: HDLC: CS1/FCS, DIS/FCS.SIG.END
426
428
430
FLAGS
T30 IND: FLAGS
432
TS1
V.21: HDLC: TS1/FCS
434
DCS
V.21: HDLC: DCS/FCS
TCF
436
440
FLAGS
T30 IND: FLAGS
CFR
V.21: HDLC: CFR/FCS
438
442
TRAINING
T30 IND: SPEED
444
IMAGE DATA
V.17: NON-ECM: IMAGE DATA
446
V.17: NON-ECM: IMAGE DATA: NON-ECM.SIG.END
448
FLAGS
T30 IND: FLAGS
EOP
450
V.21: HDLC: EOP/FCS
T30 IND: FLAGS
FLAGS
MCF
452
V.21: HDLC: MCF/FCS
FLAGS
T30 IND: FLAGS
DCN
454
V.21: HDLC: DCN/FCS
DISCONNECT

FIG.23


FAX
SPOOFING
466
FAX
COMMUNICATION
468
470
HANDSHAKE
NEGOTIATOR
DATA
PUMP
472
474
ERROR
CORRECTION
MODE
NON ERROR
CORRECTION
MODE
476
476
478
HDLC
PREAMBLE
SPOOFING
HDLC
PREAMBLE
SPOOFING
ZERO BIT
FILLING
SPOOFING

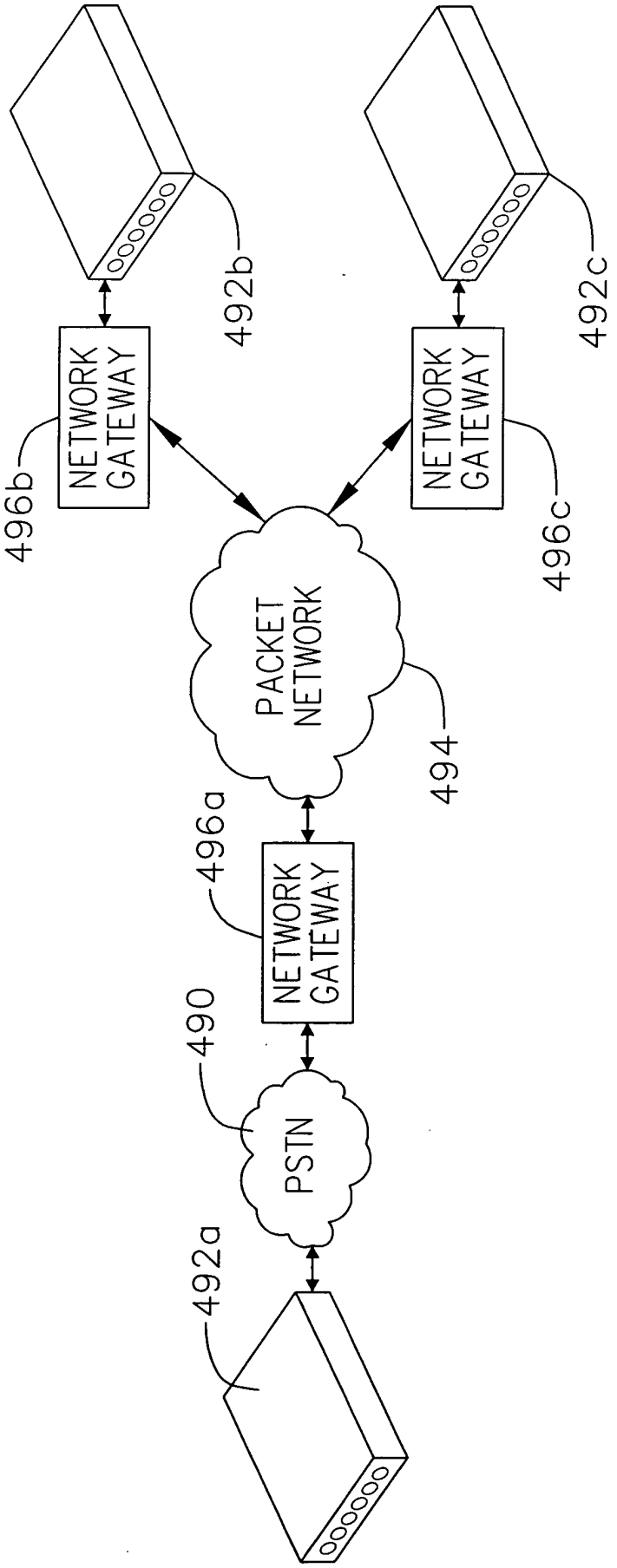

492b
492c
NETWORK GATEWAY
NETWORK GATEWAY
496b
496c
PACKET NETWORK
494
496a
NETWORK GATEWAY
490
PSTN
492a

FIG. 24

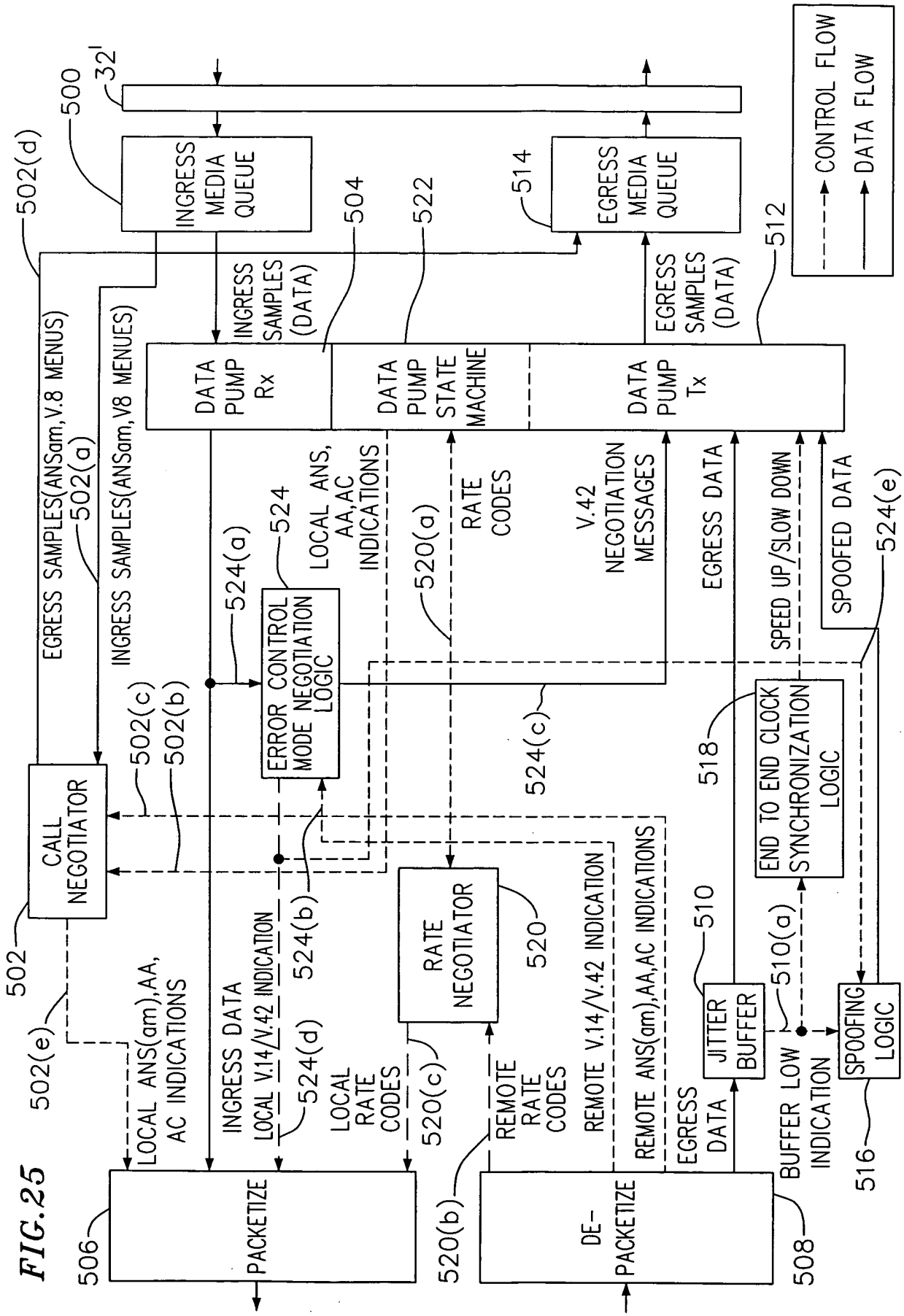

32'
500
502(d)
INGRESS MEDIA QUEUE
504
522
514
EGRESS MEDIA QUEUE
512
CONTROL FLOW
DATA FLOW
INGRESS SAMPLES (DATA)
EGRESS SAMPLES (DATA)
DATA PUMP Rx
DATA PUMP STATE MACHINE
DATA PUMP Tx
EGRESS SAMPLES(ANSam,V.8 MENUS)
502(a)
INGRESS SAMPLES(ANSam,V8 MENUES)
524(a)
524
LOCAL ANS, AA,AC INDICATIONS
520(a)
RATE CODES
V.42 NEGOTIATION MESSAGES
EGRESS DATA
SPEED UP/SLOW DOWN
SPOOFED DATA
524(e)
ERROR CONTROL MODE NEGOTIATION LOGIC
502(c)
502(b)
524(c)
518
END TO END CLOCK SYNCHRONIZATION LOGIC
CALL NEGOTIATOR
502
502(e)
LOCAL ANS(am),AA, AC INDICATIONS
INGRESS DATA
LOCAL V.14/V.42 INDICATION
524(b)
524(d)
LOCAL RATE CODES
RATE NEGOTIATOR
520
520(c)
REMOTE RATE CODES
REMOTE V.14/V.42 INDICATION
REMOTE ANS(am),AA,AC INDICATIONS
EGRESS DATA
510
JITTER BUFFER
510(a)
BUFFER LOW INDICATION
SPOOFING LOGIC
516
PACKETIZE
506
520(b)
DE-PACKETIZE
508

FIG. 25

FIG.26

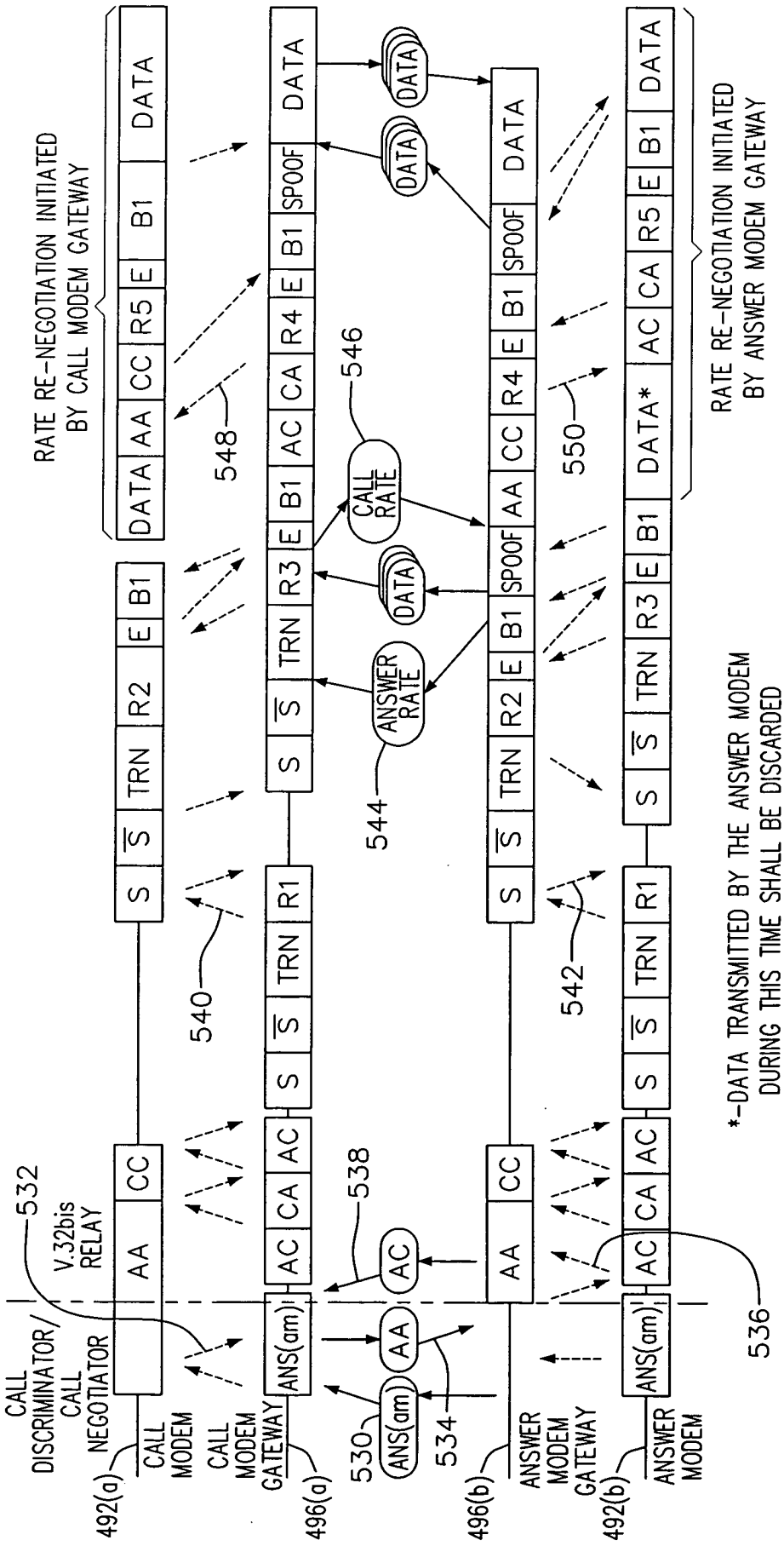

CALL DISCRIMINATOR/ CALL NEGOTIATOR
V.32bis RELAY
532
CALL MODEM
CALL MODEM GATEWAY
ANSWER MODEM GATEWAY
ANSWER MODEM
492(a)
496(a)
496(b)
492(b)
530
534
538
540
542
544
546
548
550
536
ANS(am)
ANS(am)
AA
AC
CA
CC
S
TRN
R1
R2
R3
R4
R5
E
B1
SPOOF
DATA
DATA*
ANSWER RATE
CALL RATE
RATE RE-NEGOTIATION INITIATED BY CALL MODEM GATEWAY
RATE RE-NEGOTIATION INITIATED BY ANSWER MODEM GATEWAY
*-DATA TRANSMITTED BY THE ANSWER MODEM DURING THIS TIME SHALL BE DISCARDED
-INDICATES xCHANGE PACKETS TRANSFERRED ACROSS THE NETWORK

FIG.27

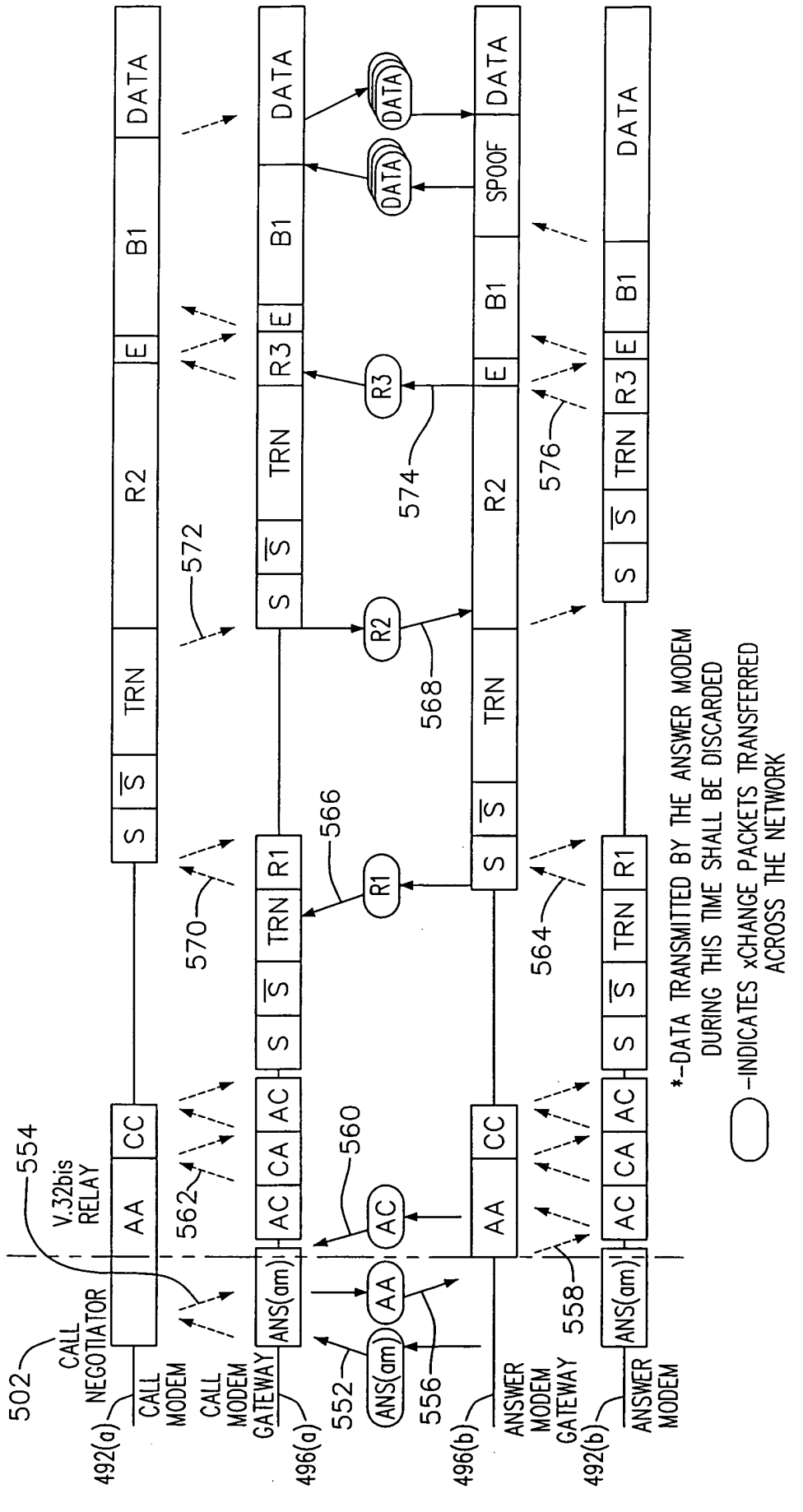

502
CALL NEGOTIATOR
554
V.32bis RELAY
492(a)
CALL MODEM
CALL MODEM GATEWAY
496(a)
552
ANS(am)
AA
CC
AC
CA
S
TRN
R1
R2
R3
E
B1
DATA
SP00F
562
560
570
566
572
574
568
576
564
558
556
496(b)
ANSWER MODEM GATEWAY
492(b)
ANSWER MODEM
*-DATA TRANSMITTED BY THE ANSWER MODEM DURING THIS TIME SHALL BE DISCARDED
-INDICATES xCHANGE PACKETS TRANSFERRED ACROSS THE NETWORK

FIG.28

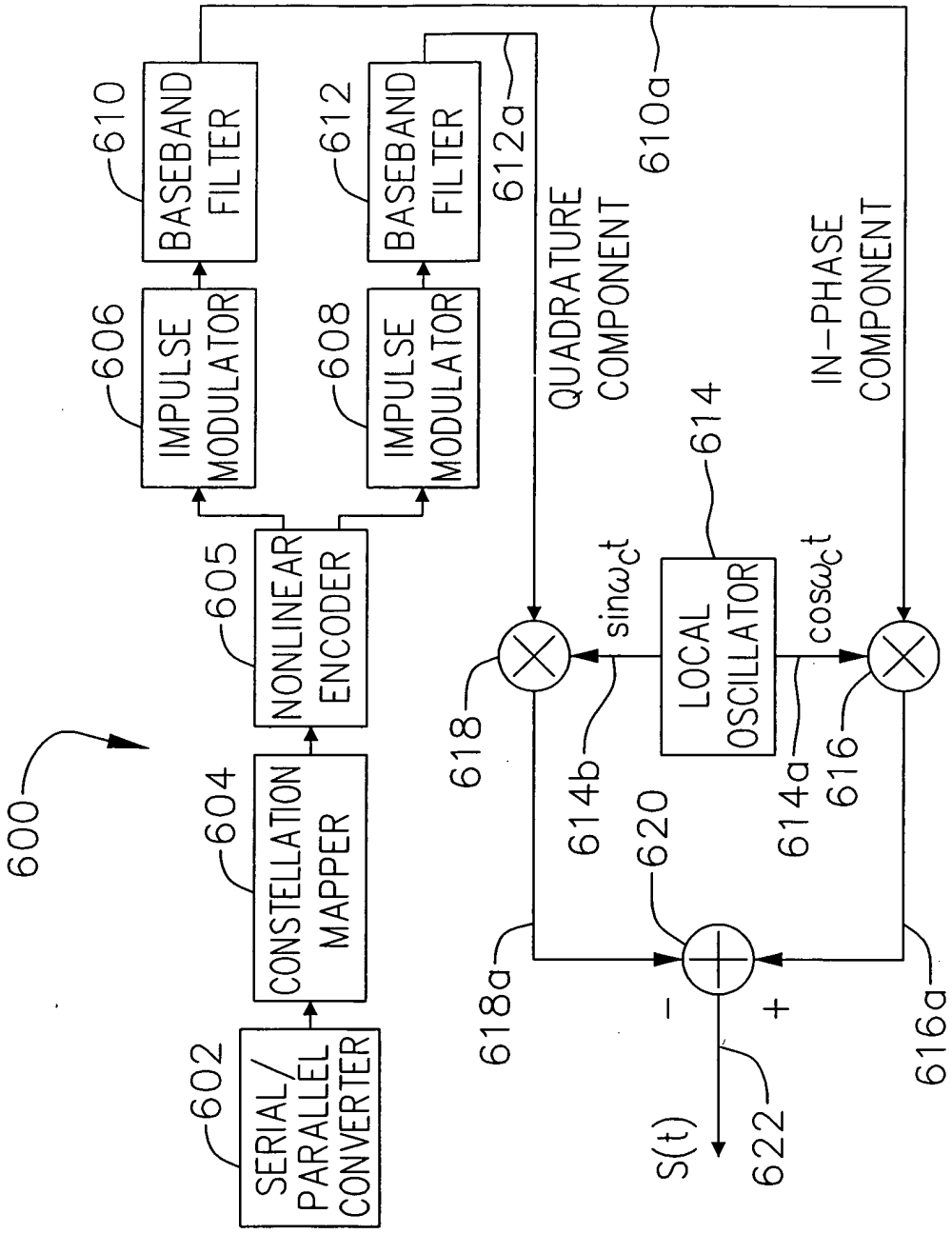
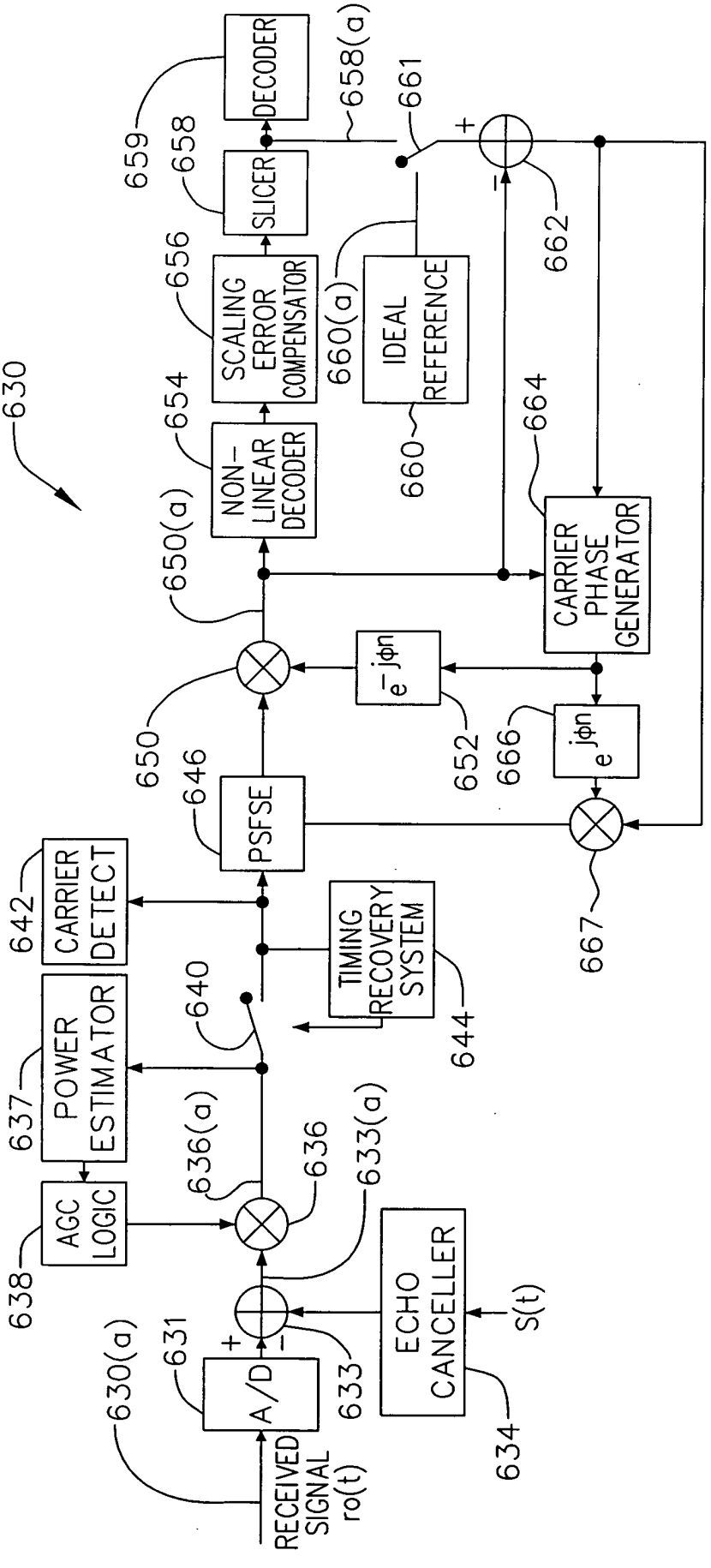

600
602
SERIAL/ PARALLEL CONVERTER
604
CONSTELLATION MAPPER
605
NONLINEAR ENCODER
606
IMPULSE MODULATOR
608
IMPULSE MODULATOR
610
BASEBAND FILTER
612
BASEBAND FILTER
612a
610a
QUADRATURE COMPONENT
IN-PHASE COMPONENT
614
LOCAL OSCILLATOR
sinωct
cosωct
618
614b
614a
616
618a
620
616a
S(t)
622
-
+

FIG.29


630
630(a)
RECEIVED SIGNAL ro(t)
631
A/D
633
633(a)
634
ECHO CANCELLER
S(t)
636
636(a)
638
AGC LOGIC
637
POWER ESTIMATOR
640
642
CARRIER DETECT
644
TIMING RECOVERY SYSTEM
646
PSFSE
650
650(a)
652
$e^{-j\phi n}$
654
NON-LINEAR DECODER
656
SCALING ERROR COMPENSATOR
658
SLICER
658(a)
659
DECODER
660
660(a)
IDEAL REFERENCE
661
662
664
CARRIER PHASE GENERATOR
666
$e^{j\phi n}$
667

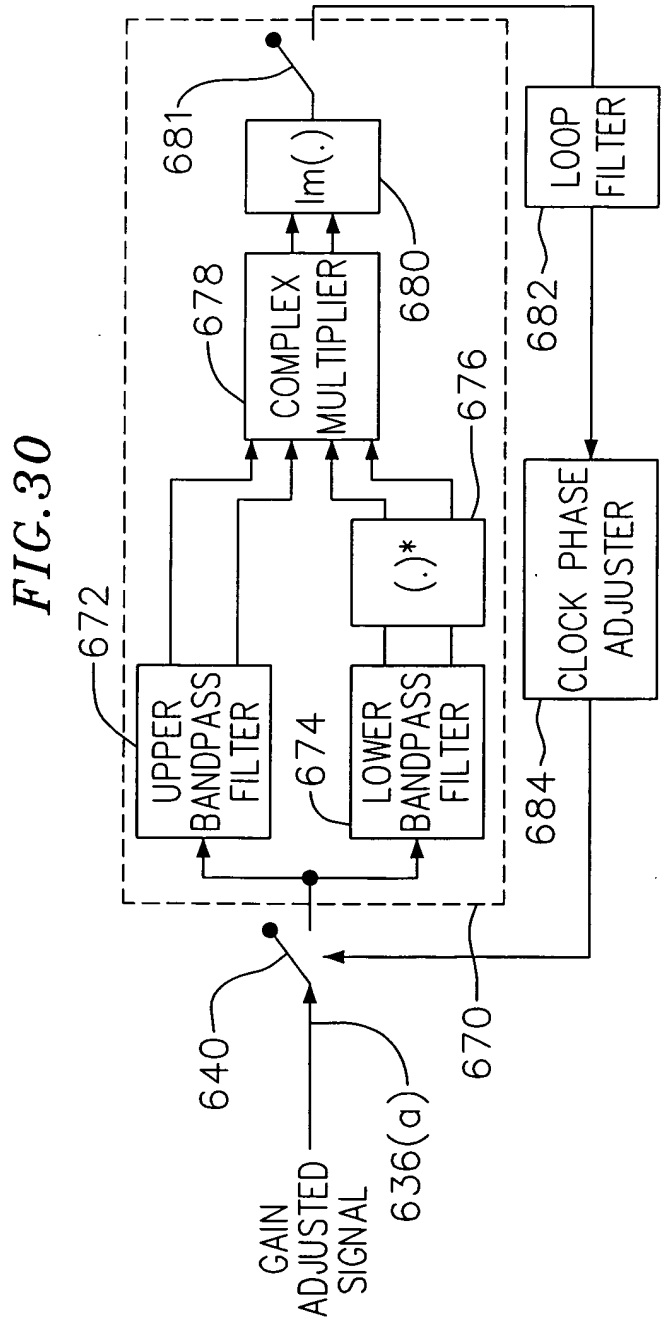

672
UPPER BANDPASS FILTER
674
LOWER BANDPASS FILTER
(.)*
676
COMPLEX MULTIPLIER
678
Im(.)
680
681
LOOP FILTER
682
CLOCK PHASE ADJUSTER
684
640
GAIN ADJUSTED SIGNAL
636(a)
670

FIG. 30

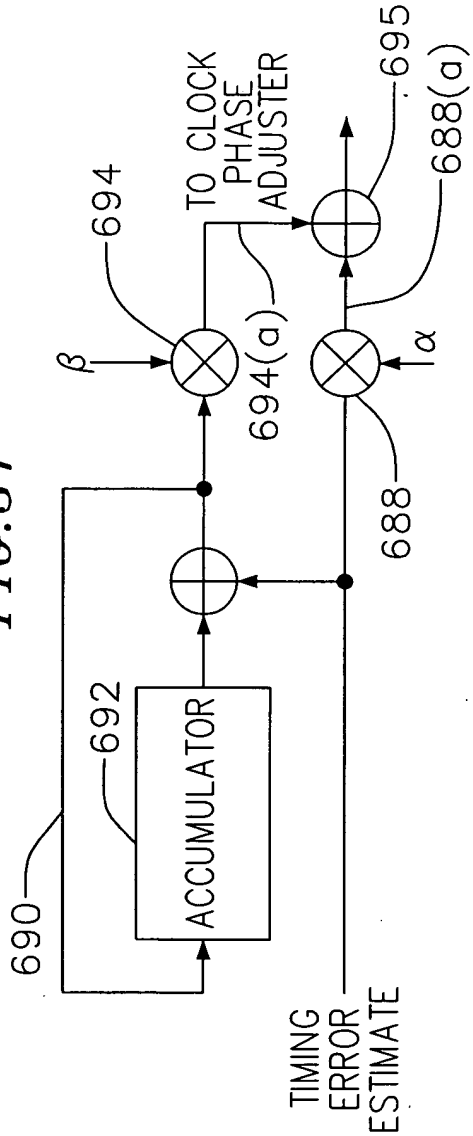

690
692
ACCUMULATOR
694
β
694(a)
TO CLOCK PHASE ADJUSTER
695
688(a)
α
688
TIMING ERROR ESTIMATE

FIG. 31

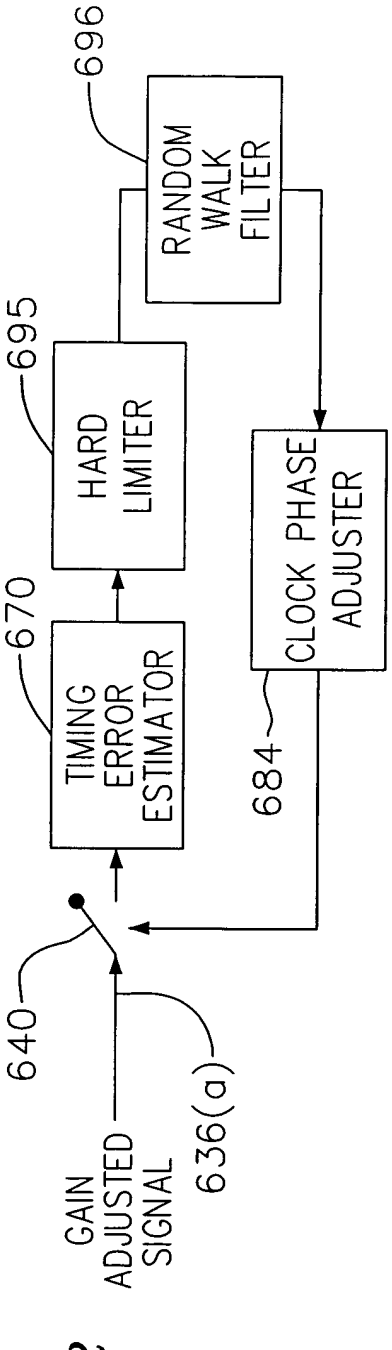

640
GAIN ADJUSTED SIGNAL
636(a)
TIMING ERROR ESTIMATOR
670
HARD LIMITER
695
RANDOM WALK FILTER
696
CLOCK PHASE ADJUSTER
684

FIG. 32

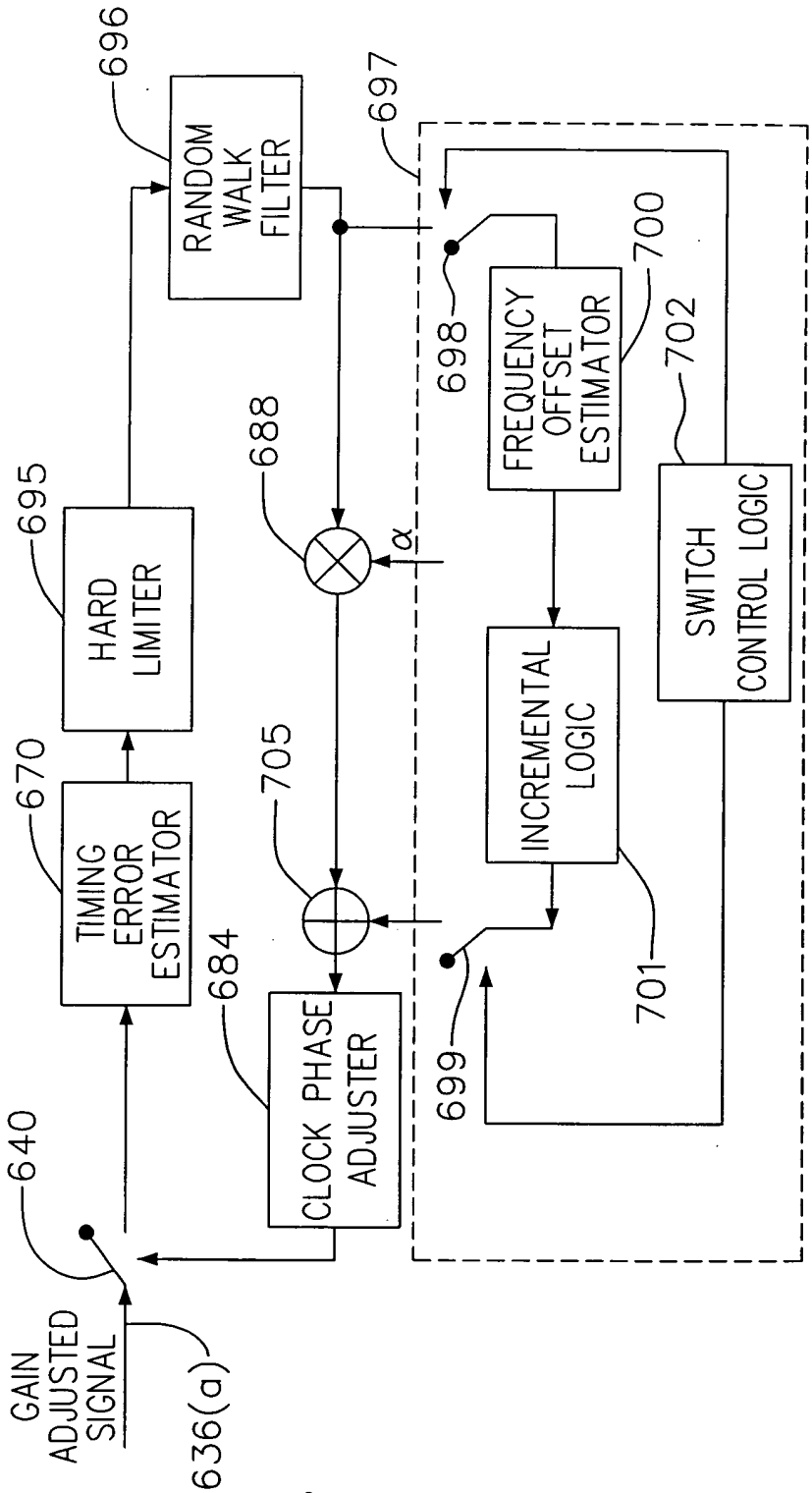
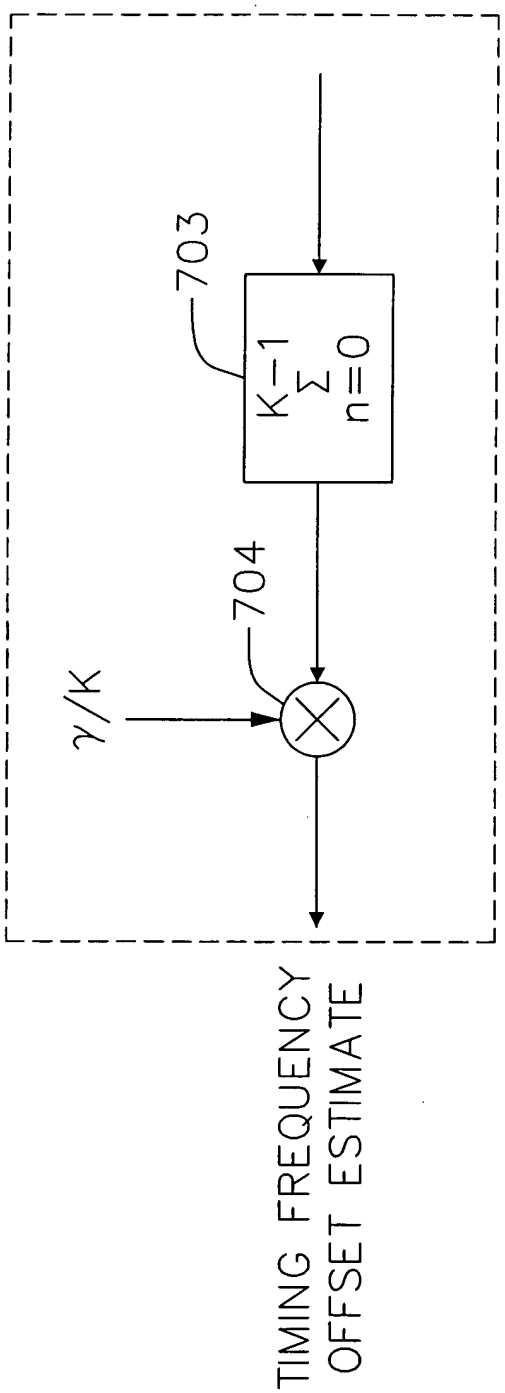

640
GAIN ADJUSTED SIGNAL
636(a)
TIMING ERROR ESTIMATOR
670
HARD LIMITER
695
RANDOM WALK FILTER
696
CLOCK PHASE ADJUSTER
684
705
688
α
697
698
FREQUENCY OFFSET ESTIMATOR
700
702
INCREMENTAL LOGIC
SWITCH CONTROL LOGIC
699
701

FIG. 33

FIG. 34



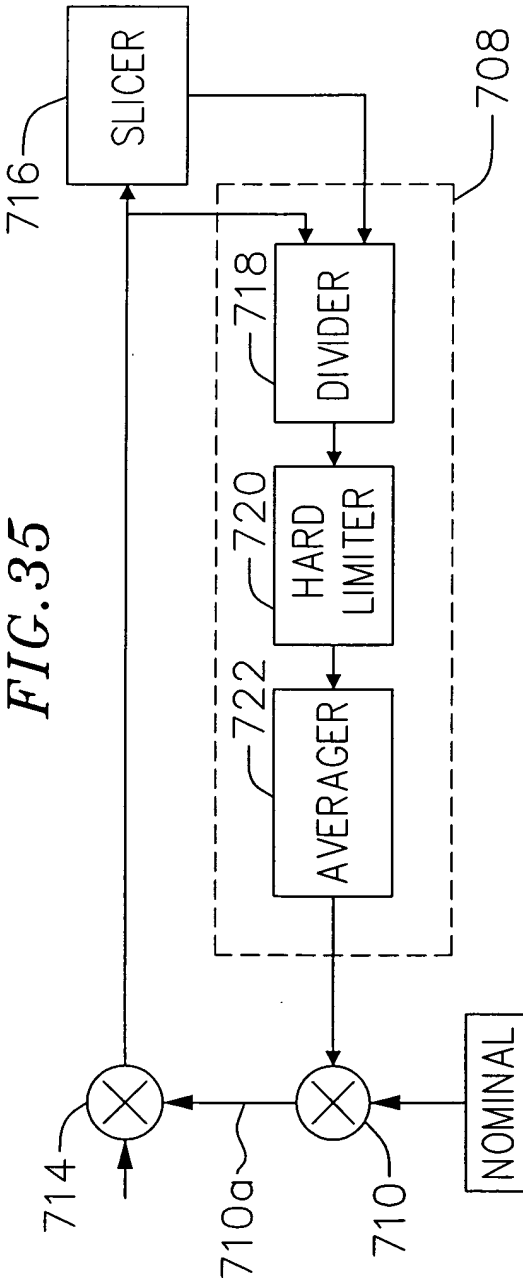

SLICER
716
708
DIVIDER
718
HARD LIMITER
720
AVERAGER
722
NOMINAL SCALE FACTOR
712
714
710a
710

FIG. 35

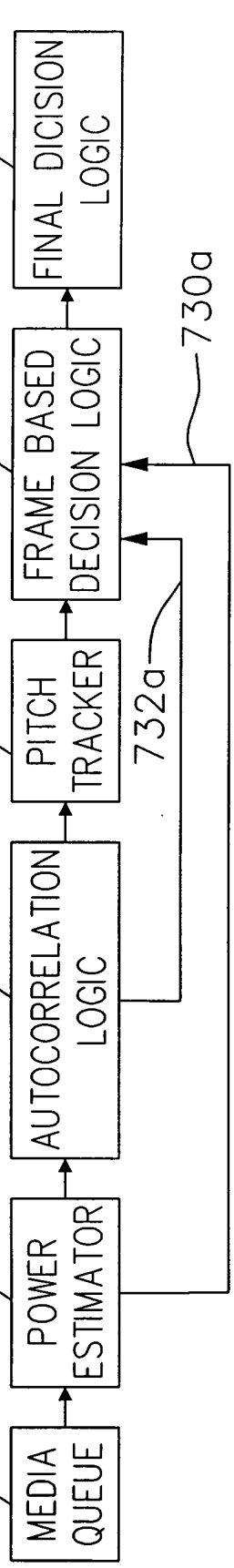

MEDIA QUEUE
66
POWER ESTIMATOR
730
AUTOCORRELATION LOGIC
732
PITCH TRACKER
734
FRAME BASED DECISION LOGIC
736
FINAL DICISION LOGIC
738
732a
730a

FIG. 36